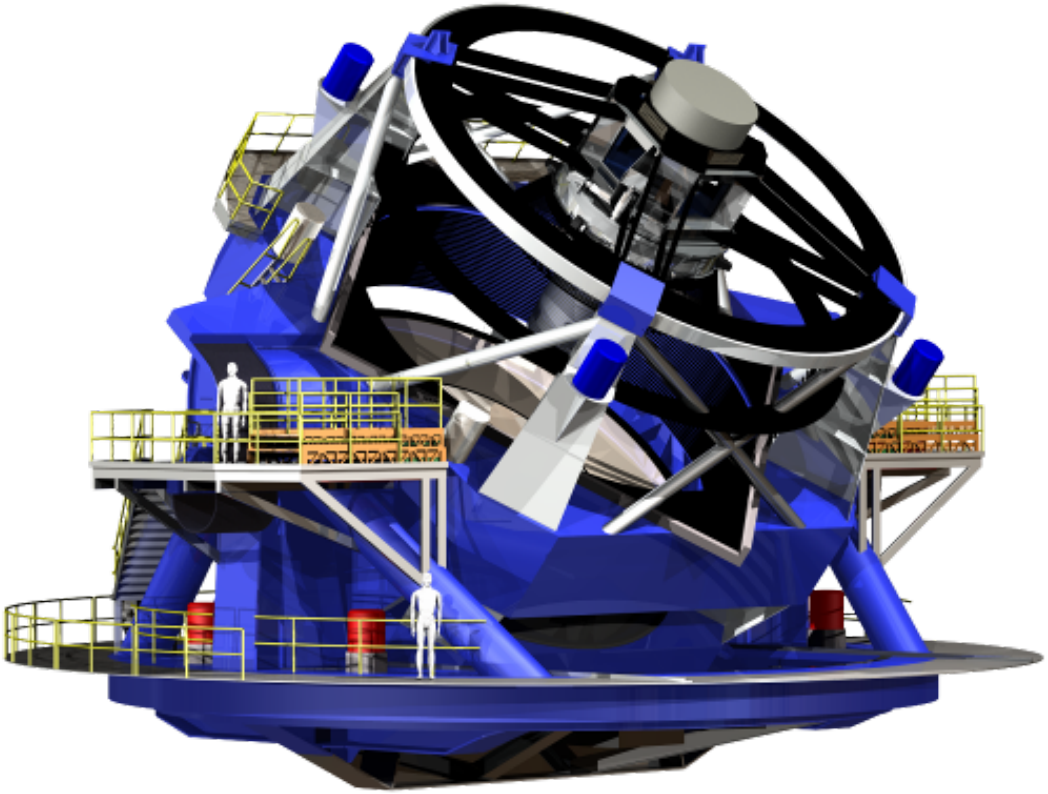
Large Synoptic Survey Telescope

LSST is a public-private partnership. Design and development activity is supported in part by the National Science Foundation. Additional funding comes from private gifts, grants to universities, and in-kind support at Department of Energy laboratories and other LSSTC Institutional Members.

LSST will build a dedicated observing facility, complete a 10 year survey, and serve its data products



- *8.4 M Primary Aperture*
- 3.5 Degree Field Of View
- 3.2 Billion Pixel Camera
- ~40 Second Cadence
  - Two 15 second exposures
  - Full sky coverage every few nights
- Data Served to Public
  - Alerts of new events
  - Catalogs of object
  - Archives of images
- Education and Public Outreach is provided

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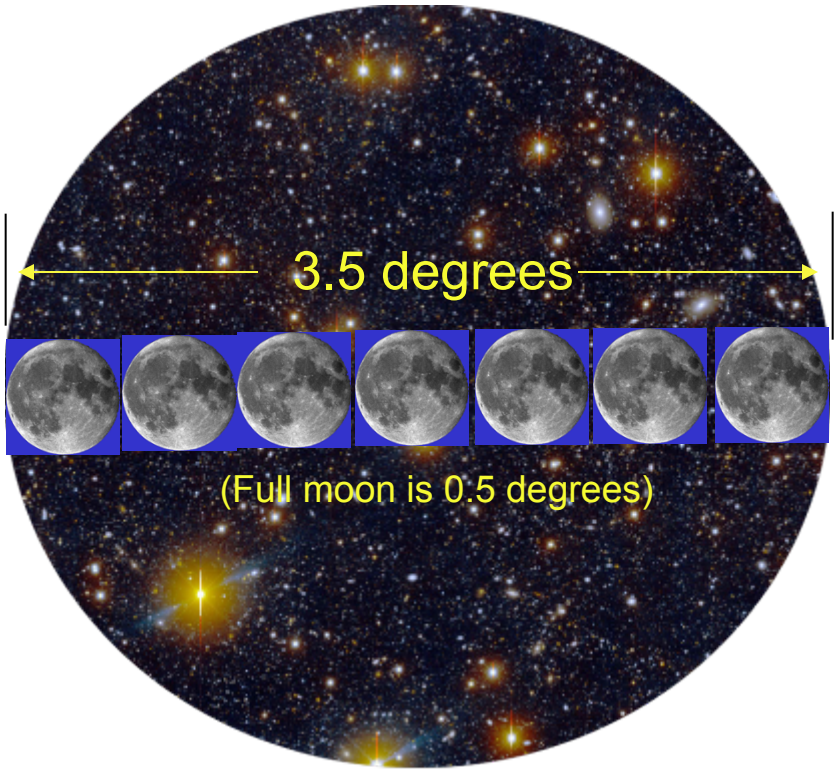

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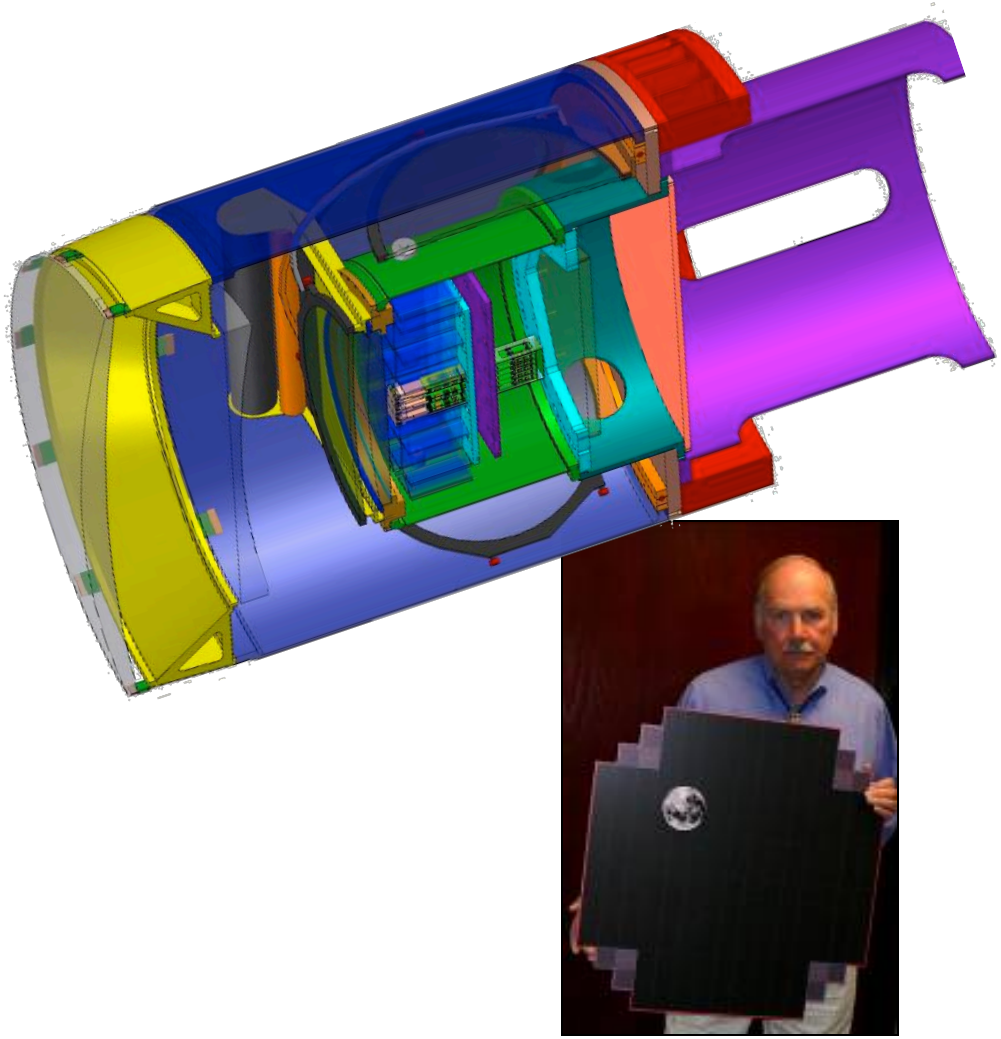

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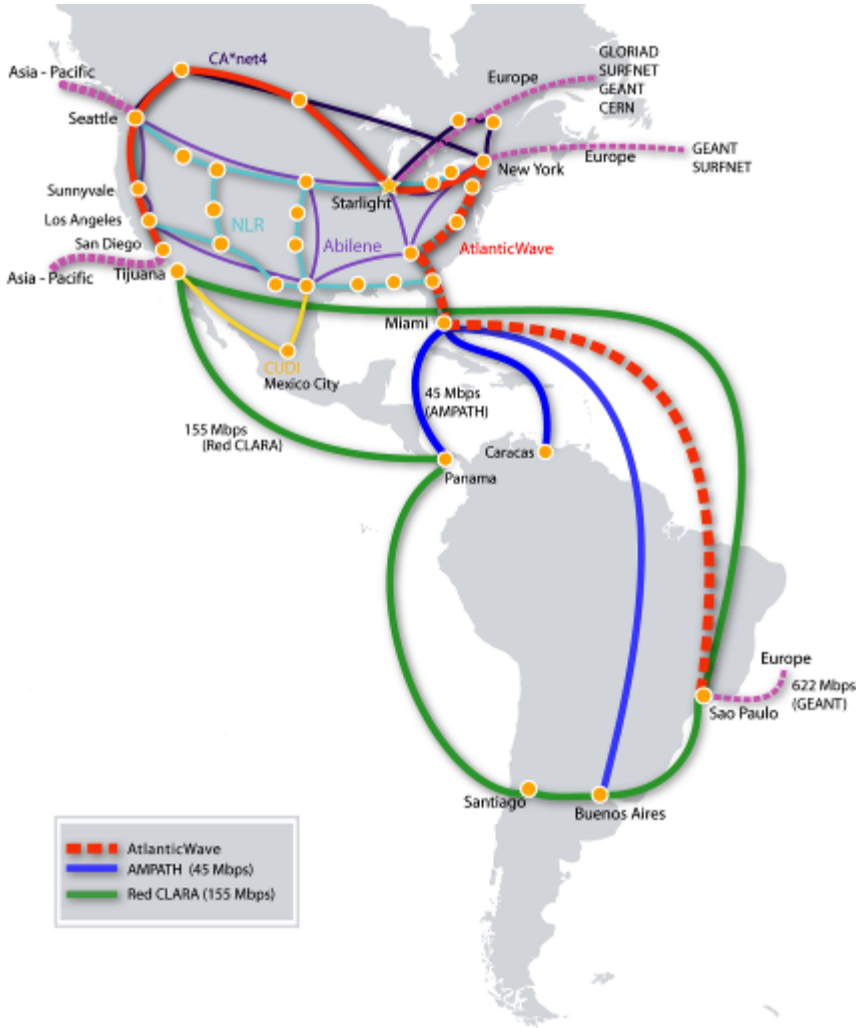

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  - Archives of images
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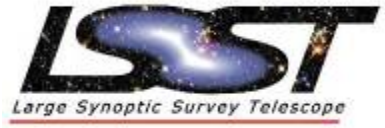
LSST Wide-Fast-Deep Survey designed to satisfy massively parallel astrophysics



- 6 filter survey of 20,000 deg^2 to ~27 mag co-added depth
- One 6-Gigabyte image every 17 seconds
- 15 Terabytes raw data every night for 10 years
- 100-Petabyte final image data archive anticipated
- 20-Petabyte final database catalog anticipated
- Real-Time Event Mining: ~100,000 events per night, every night, for 10 yrs
- Repeat images of the entire night sky every 3 nights

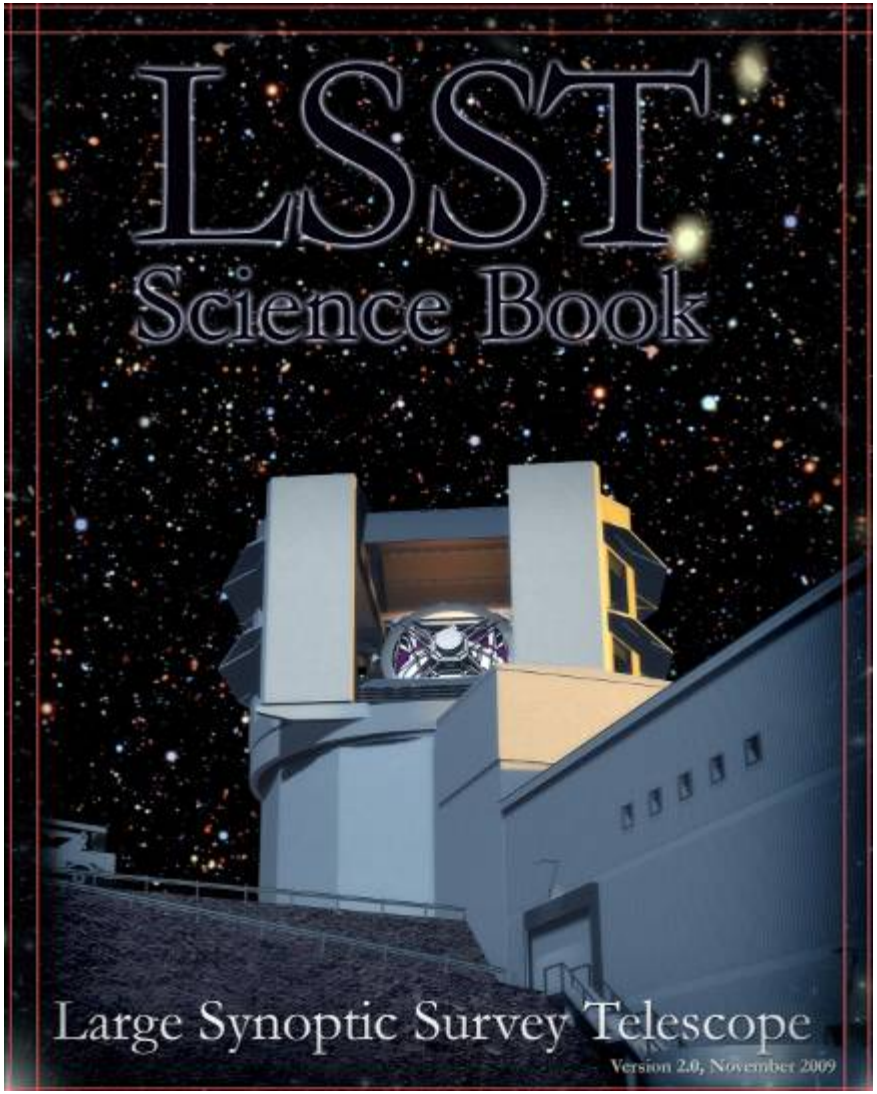
LSST is an unprecedented survey

- Enables broad qualitative leap
  - potentially hazardous near-Earth asteroids
  - to the fundamental physics of dark energy
- 20 billion objects cataloged
- 4 billion galaxies with redshifts
- Time domain information x1000
  - **1 million supernovae**
  - **1 million galaxy lenses**
- High precision, high uniformity, calibrated data
- Open source, open data
- Bridge to formal education and life long learners
- Movie of the universe opens new windows
- Broader impact, from technology to public outreach

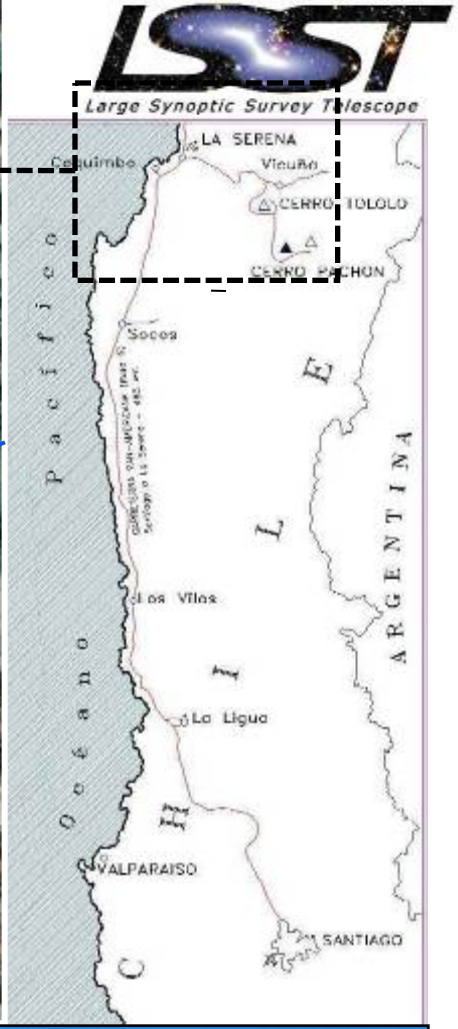
LSST Science Book, v2.0 is available now

- Strong case made for variety of science
- 245 contributors
- 598 pages
- Living document available at www.lsst.org
- arXiv/0912.0201

http://www.lsst.org/lsst/scibook

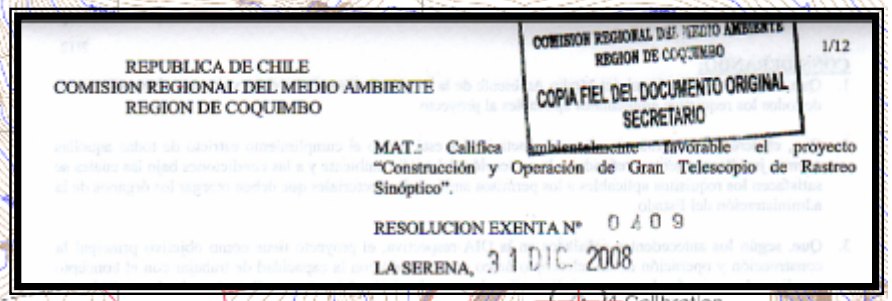


The site has been chosen on Cerro Pachón, Chile



The site civil design and permitting is done and is ready for initial excavation

- Chilean agreement in place
- Environmental assessment is complete and all building and use permits are in hand.


REPUBLICA DE CHILE
COMISION REGIONAL DEL MEDIO AMBIENTE
REGION DE COQUIMBO

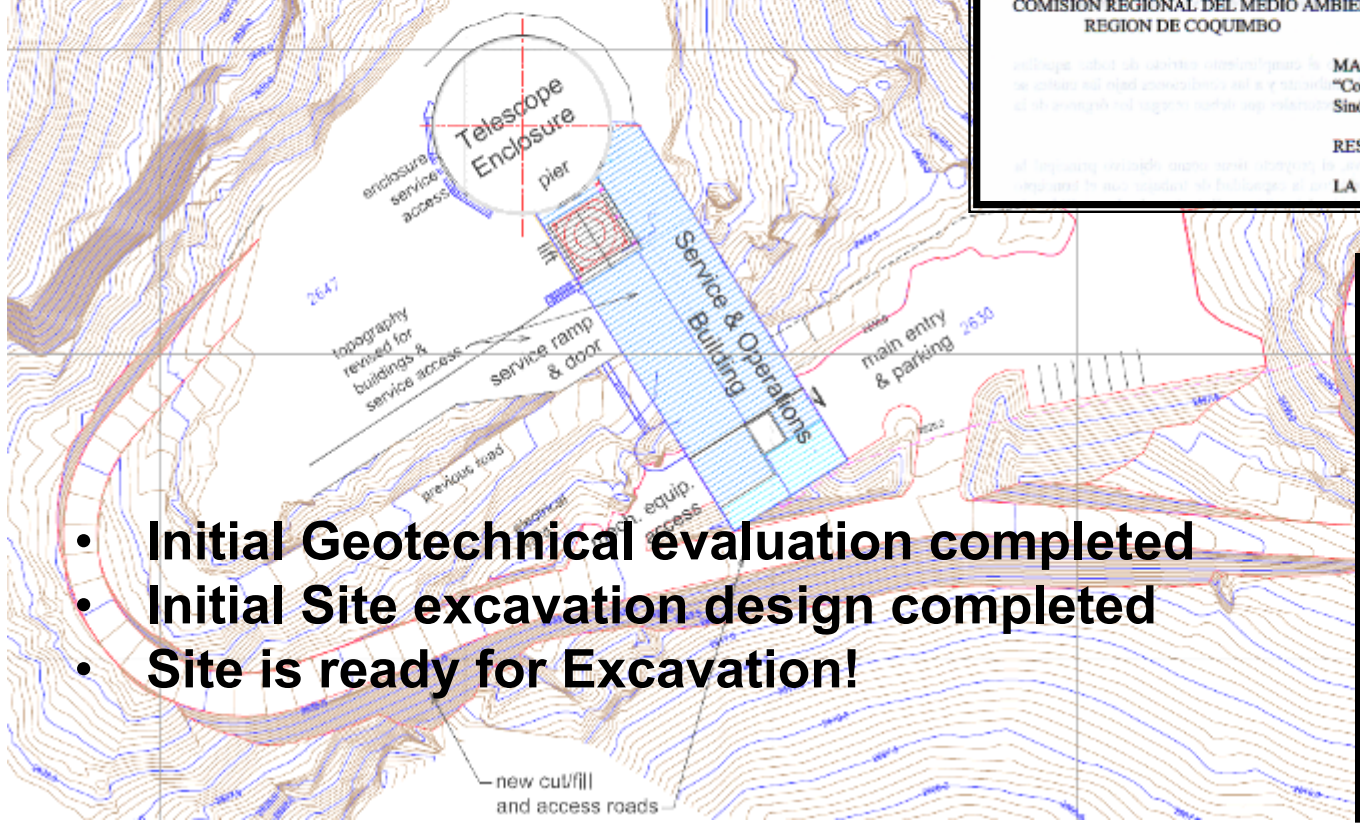
COMISION REGIONAL DEL MEDIO AMBIENTE
REGION DE COQUIMBO
COPIA FIEL DEL DOCUMENTO ORIGINAL
SECRETARIO

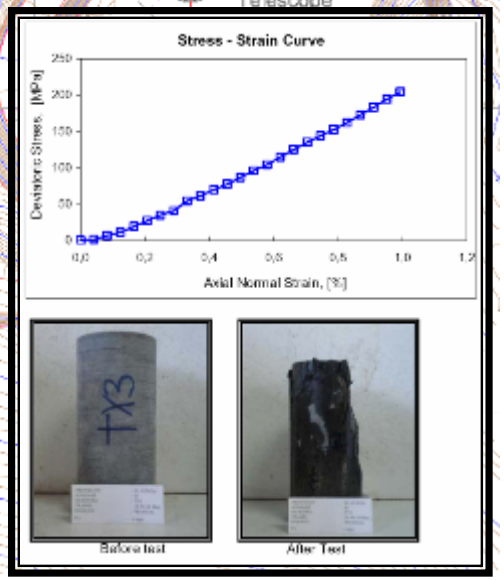
1/12

MAT.: Califica ambientalmente favorable el proyecto "Construcción y Operación de Gran Telescopio de Rastreo Sinóptico".

RESOLUCION EXENTA N° 0409

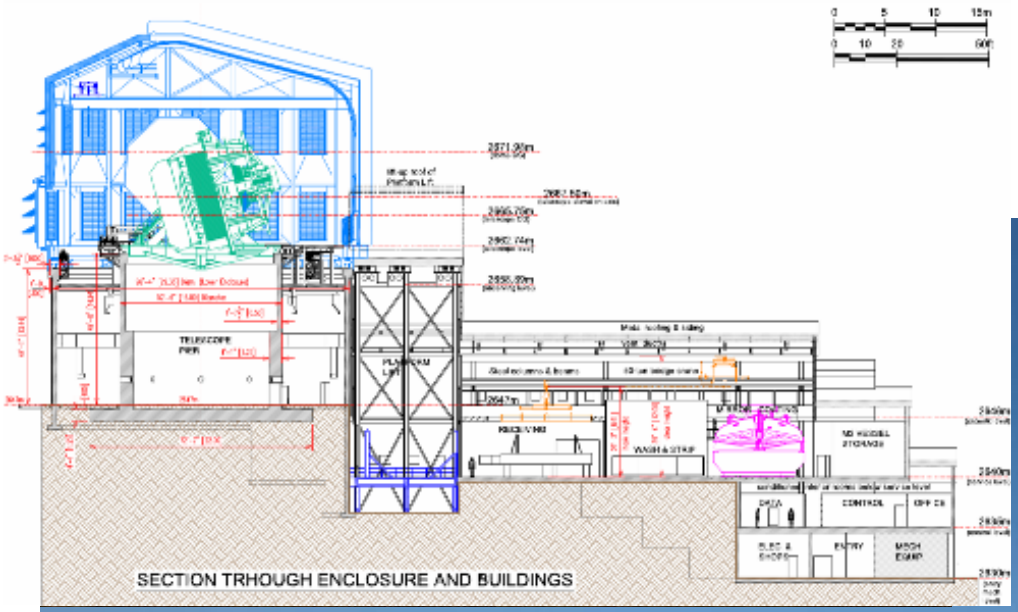
LA SERENA, 31 DIC. 2008

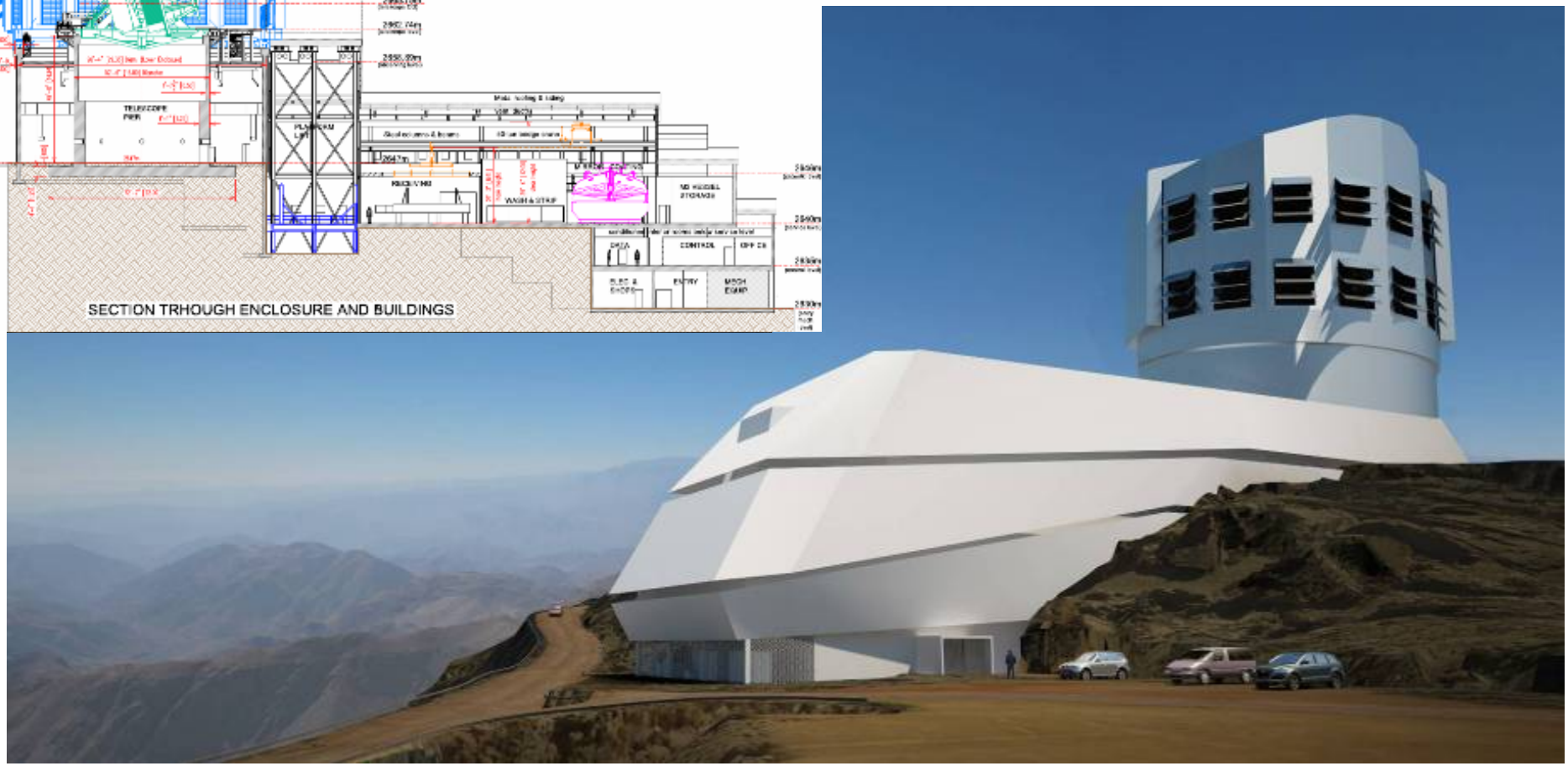




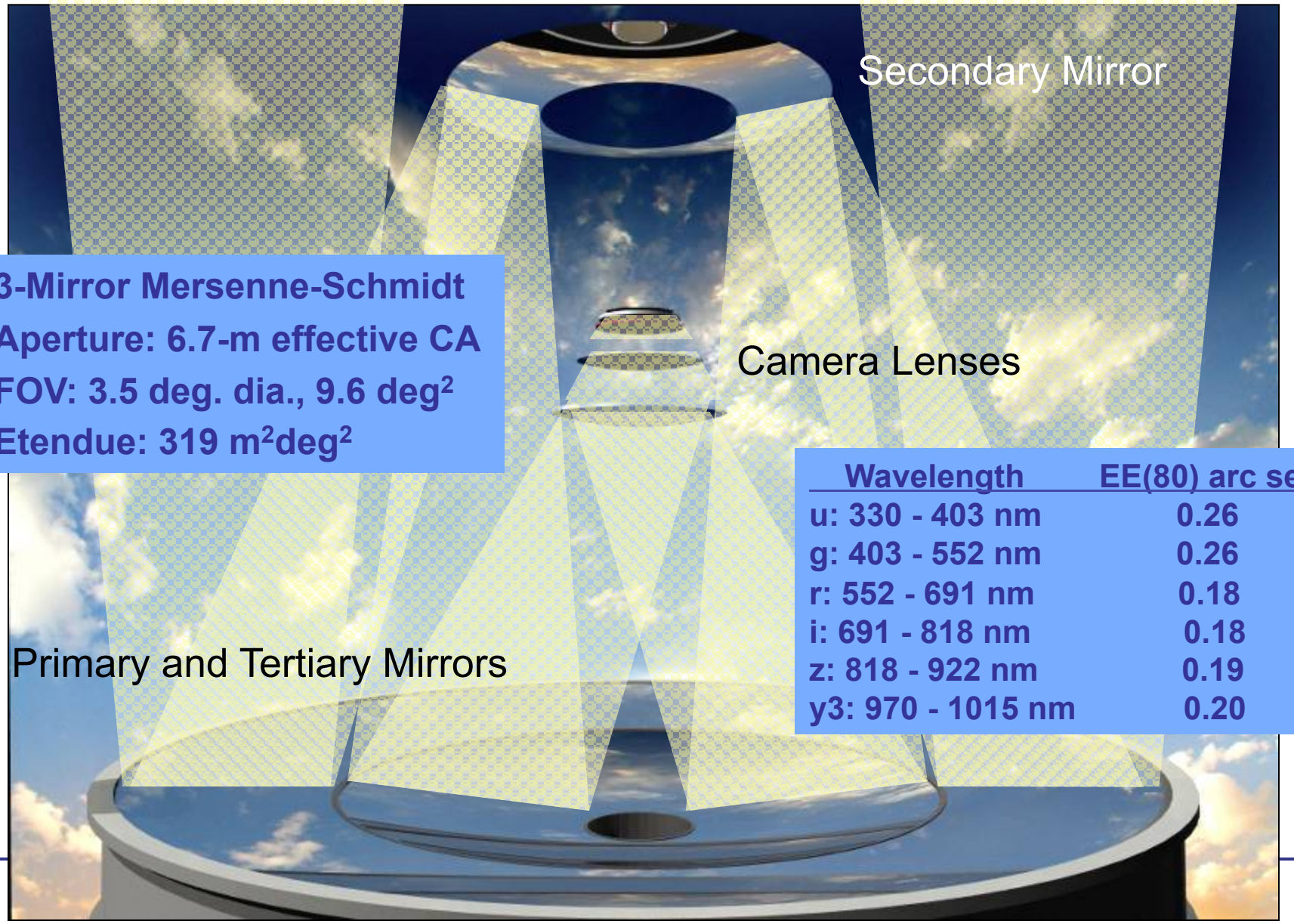
- Initial Geotechnical evaluation completed
- Initial Site excavation design completed
- Site is ready for Excavation!

Summit facility final design under contract with ARCADIS Geotecnica, Santiago Chile





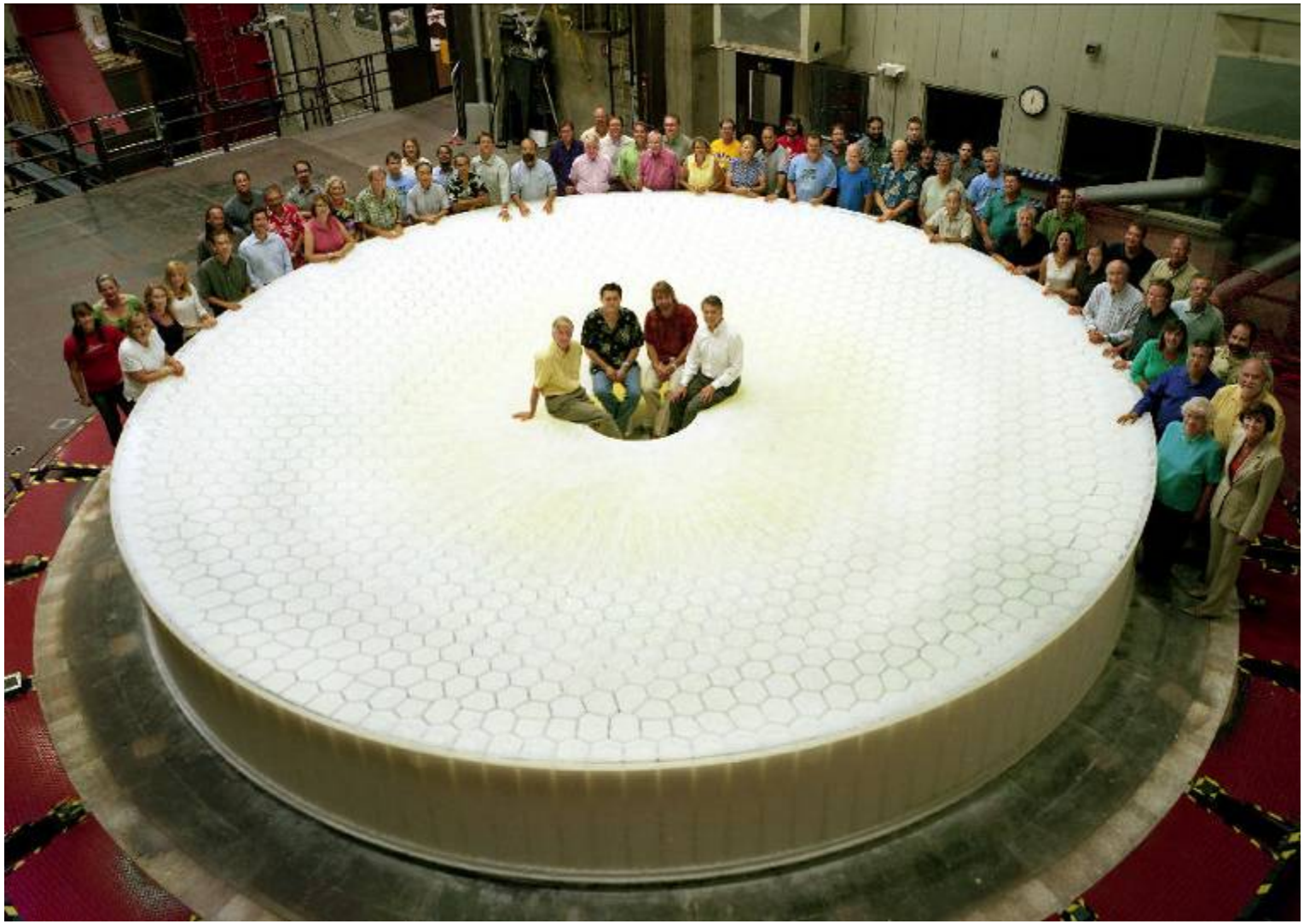
The LSST optical system is 3 mirrors and 3 lenses to form 3.5° field of view – Minor adjustments to V3.3



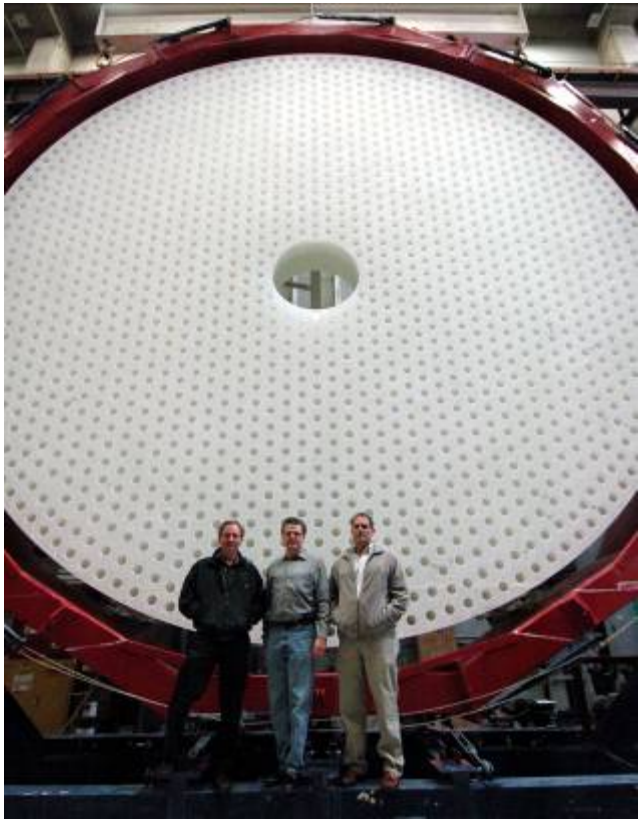
- 3-Mirror Mersenne-Schmidt
- Aperture: 6.7-m effective CA
- FOV: 3.5 deg. dia., 9.6 deg^2
- Etendue: 319 m^{2}deg^2

Wavelength	EE(80) arc sec
u: 330 - 403 nm	0.26
g: 403 - 552 nm	0.26
r: 552 - 691 nm	0.18
i: 691 - 818 nm	0.18
z: 818 - 922 nm	0.19
y3: 970 - 1015 nm	0.20

LSST M1M3 Mirror contracted to UofA with LSST non-federal funds, shown here just after casting in 2008



Primary mirror was cleaned out, inspected, and moved to optical shop

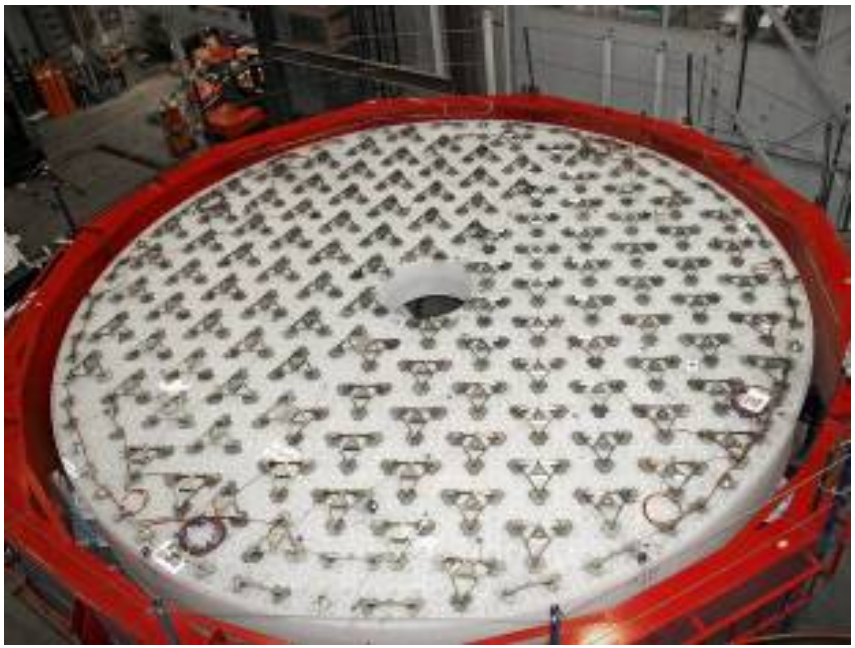


Doug, Don, and Bill in front of the cleaned out mirror

Mirror being turned onto its front for back surface processing

M1M3 on the SOML large optics generator for rear surface preparation

M1/M3 Primary mirror load spreaders attached and polishing cell ready

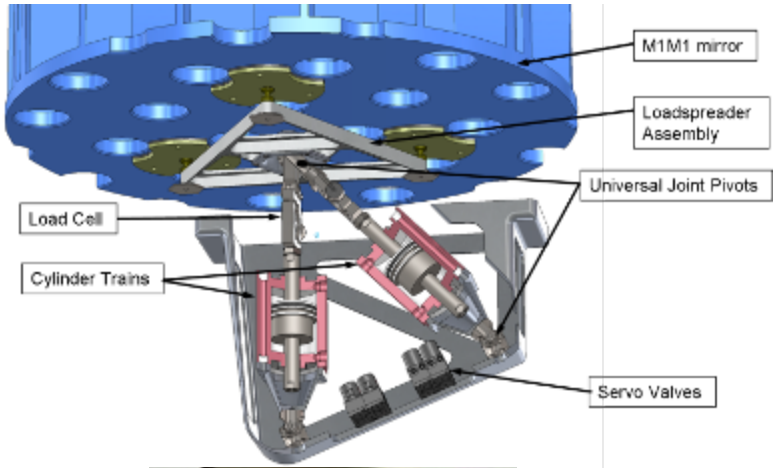


M1M3 front surface generation completed – M3 Appears!

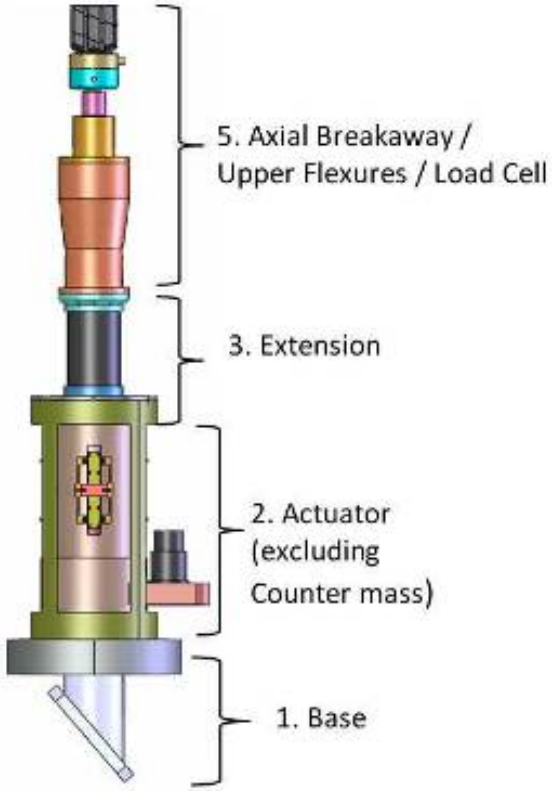
Machine incident with mirror will be a 2-3 week delay, surface damaged but repair will restore full function

M1M3 Testing utilizes holographic interferometery and SOML laser tracker plus

Telescope team at NOAO is focused on design, prototype, & testing mirror supports



Hileman 7739-143 Thursday 6:00 PM



DeVries 7739-142 Wednesday 11:20 AM

M2 Substrate purchased and completed by Corning using LSST non-federal funding

The telescope mount detailed development continues at NOAO

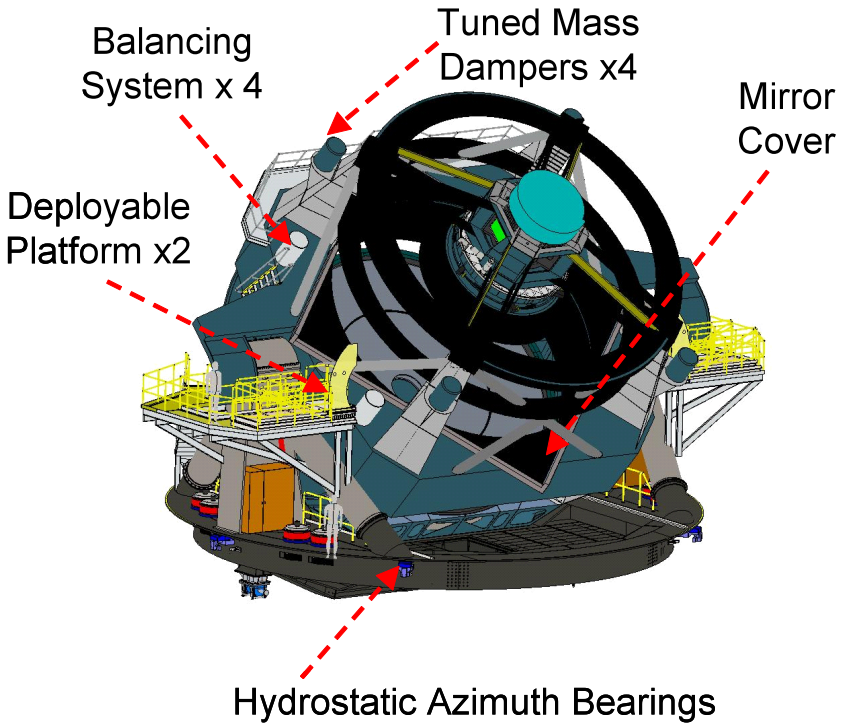
Moving structure: 300 tons

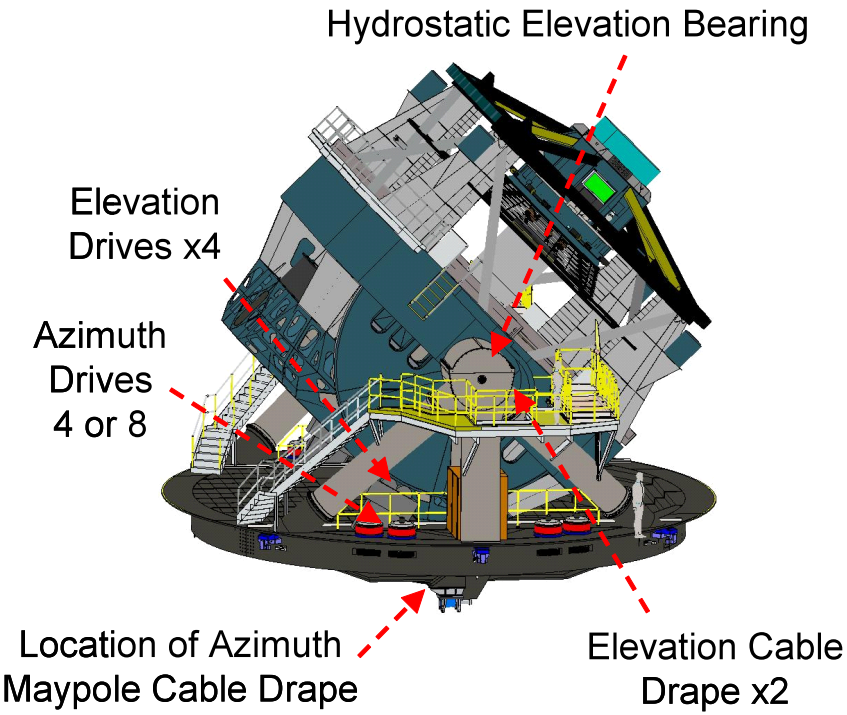
Drive power: 450 hp

Damping: Tuned masses raise damping to 5%

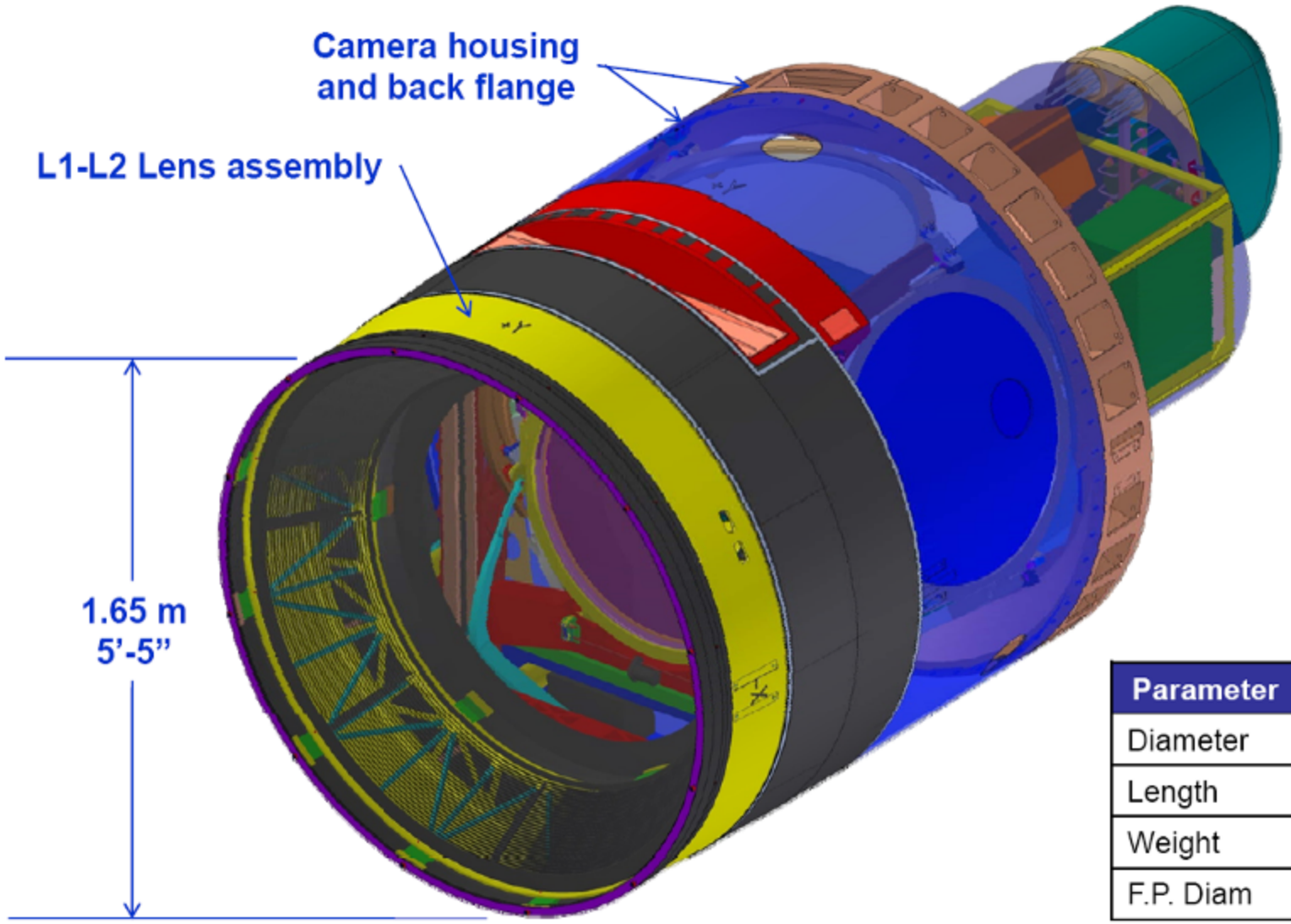
First Frequency: 8.2 hz (loaded structure on bearings, pier, and summit rock)

D. Neill 7733-11 Today 2:40 PM

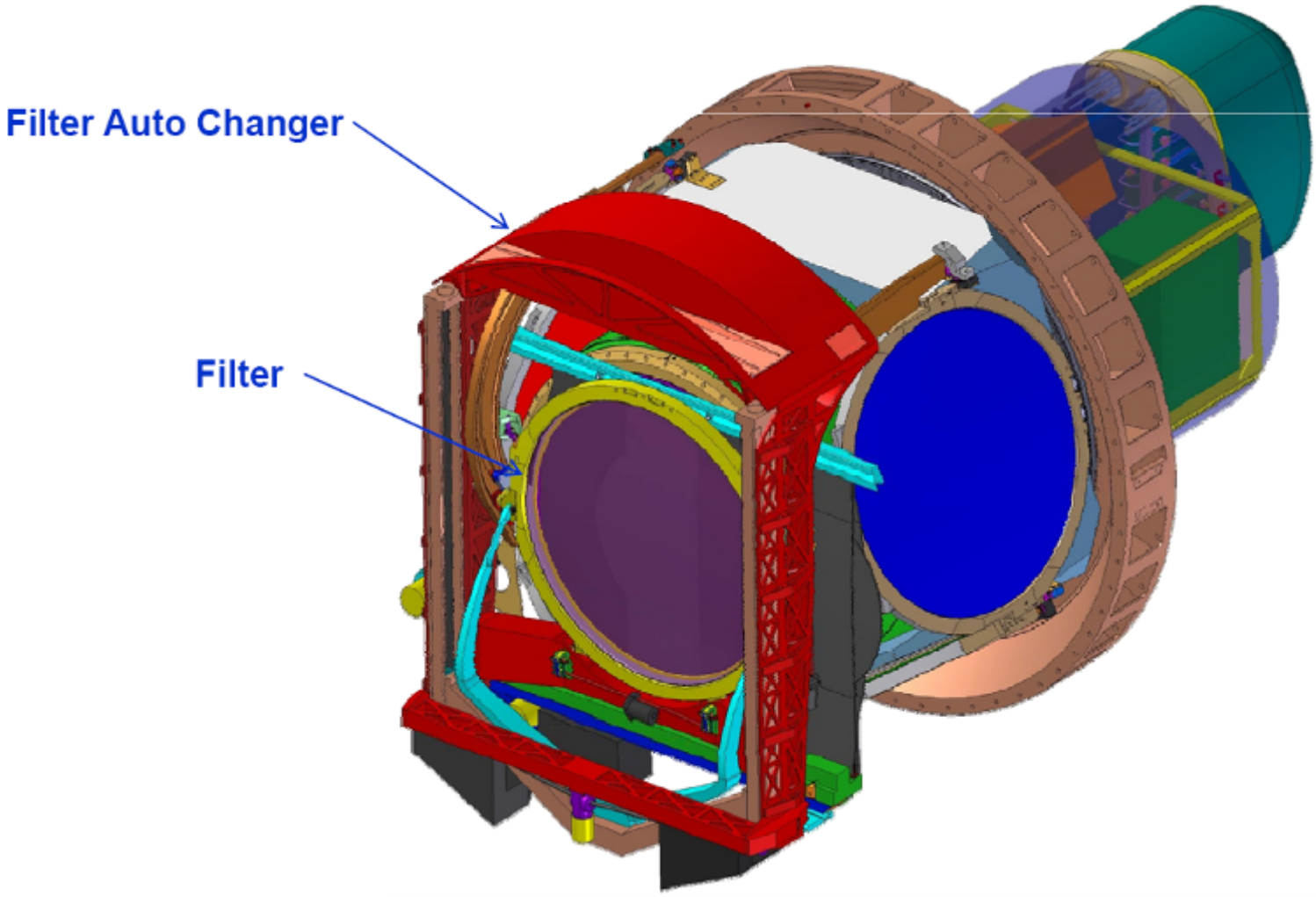


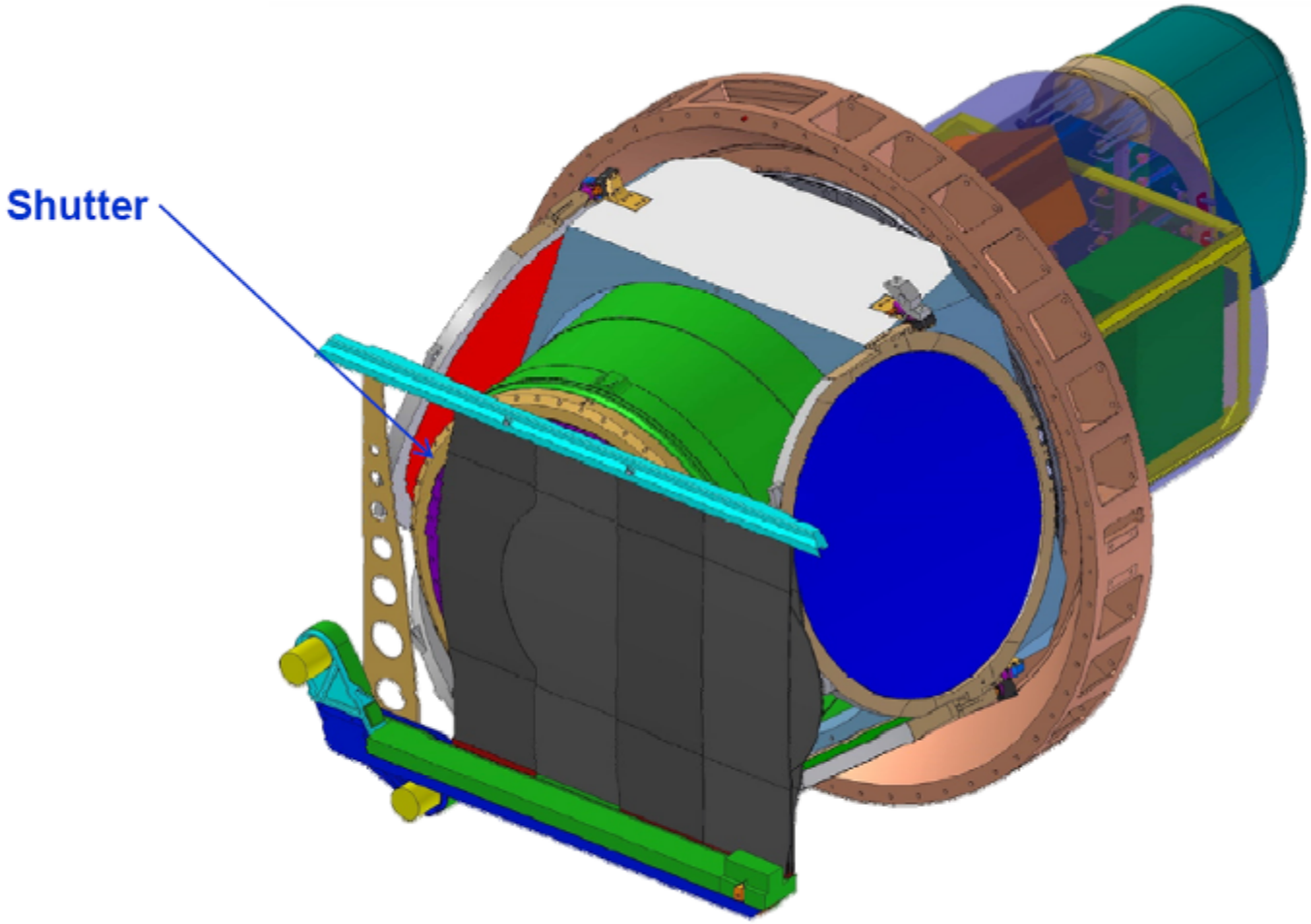


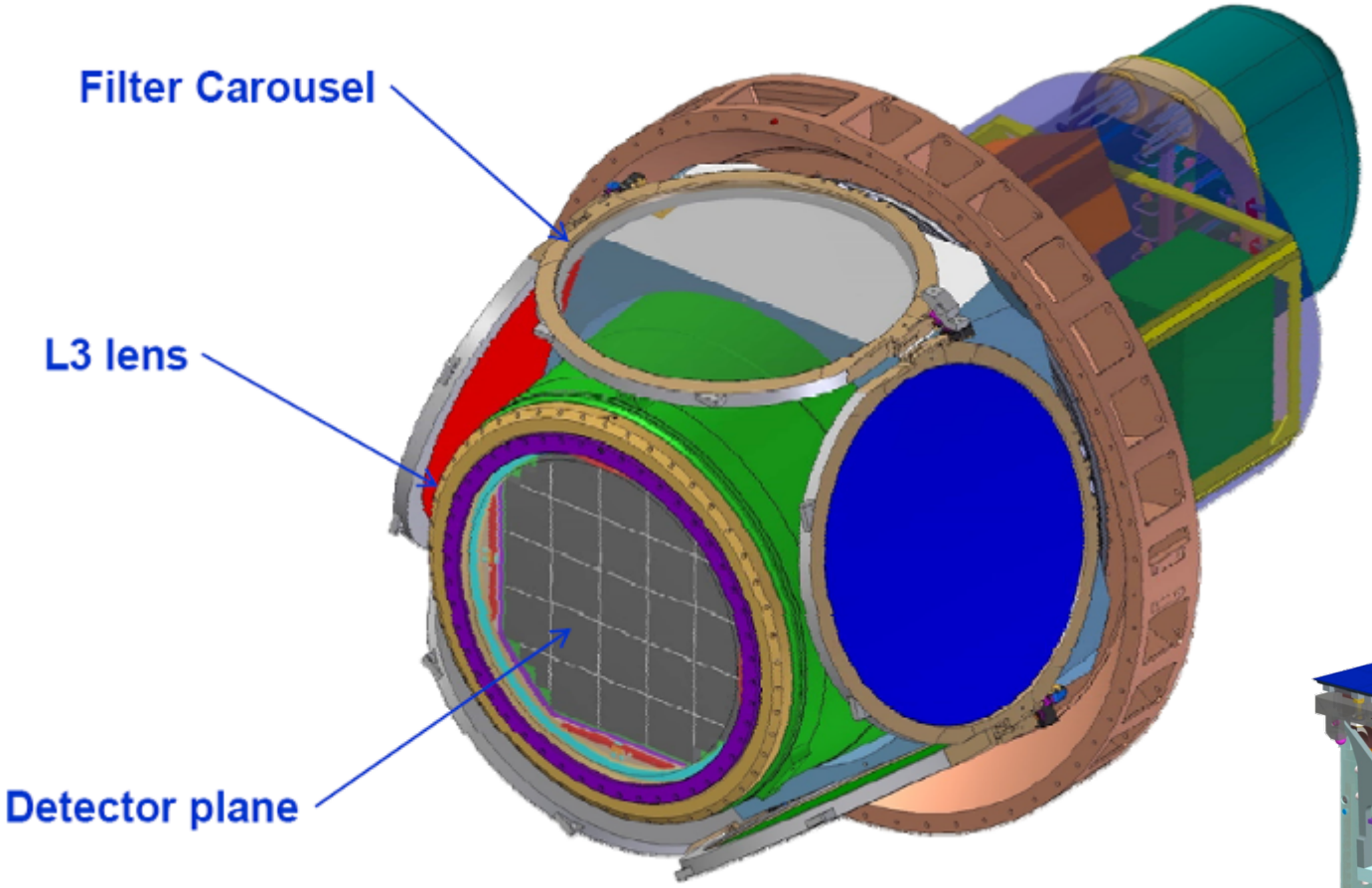
SLAC, DOE Labs and French IN2P3 Labs making good progress with design and critical prototypes

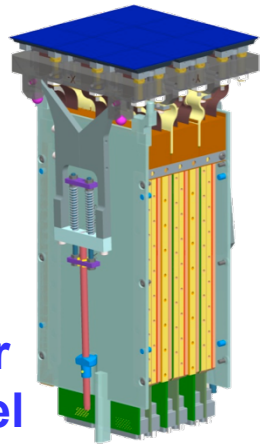


Parameter	Value
Diameter	1.65 m
Length	3.7 m
Weight	3000 kg
F.P. Diam	634 mm


Filter Auto Changer
Filter

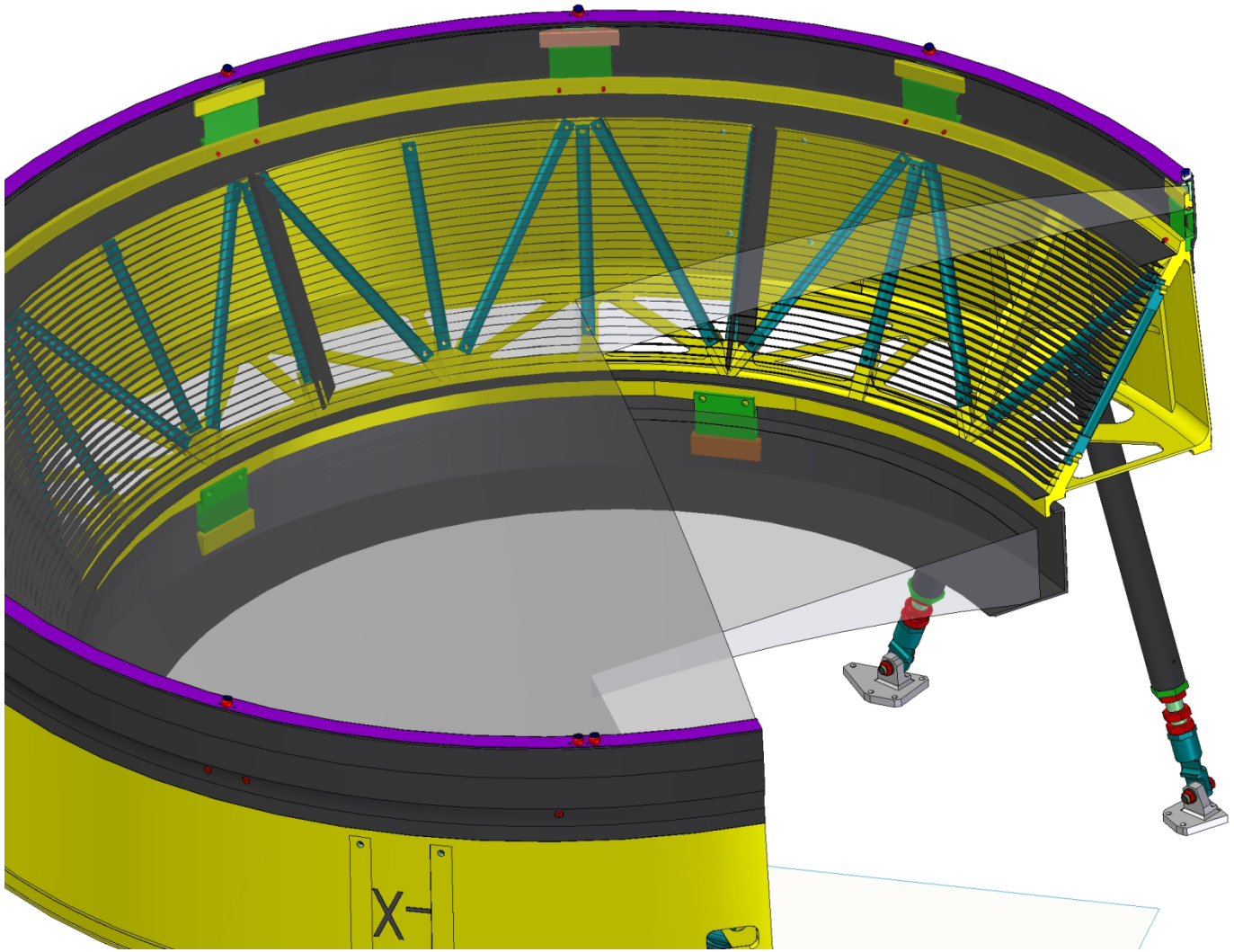

Shutter



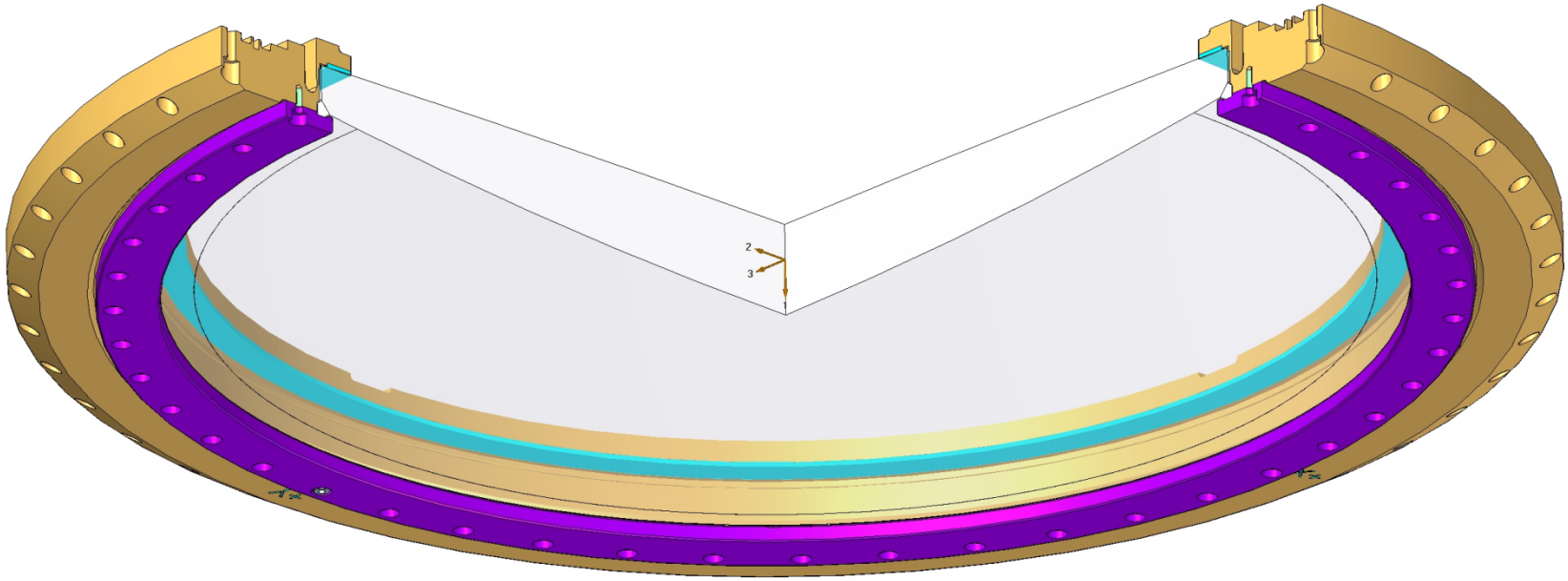


Twenty one, 9 sensor rafts - each 144 Mpixel

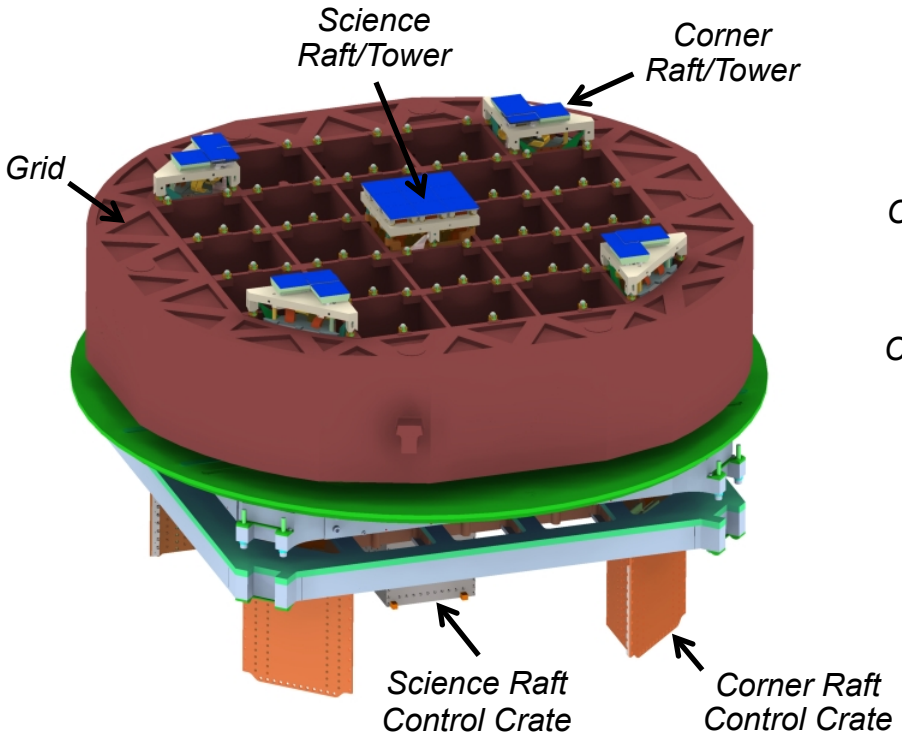
L1/L2 Assembly mechanical components

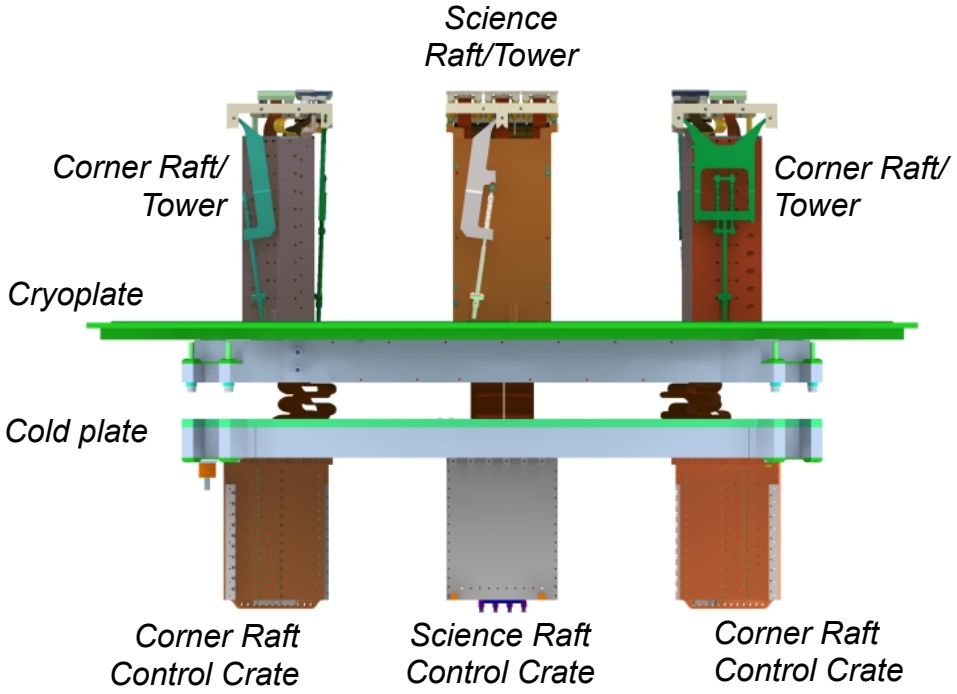


L3 Assembly

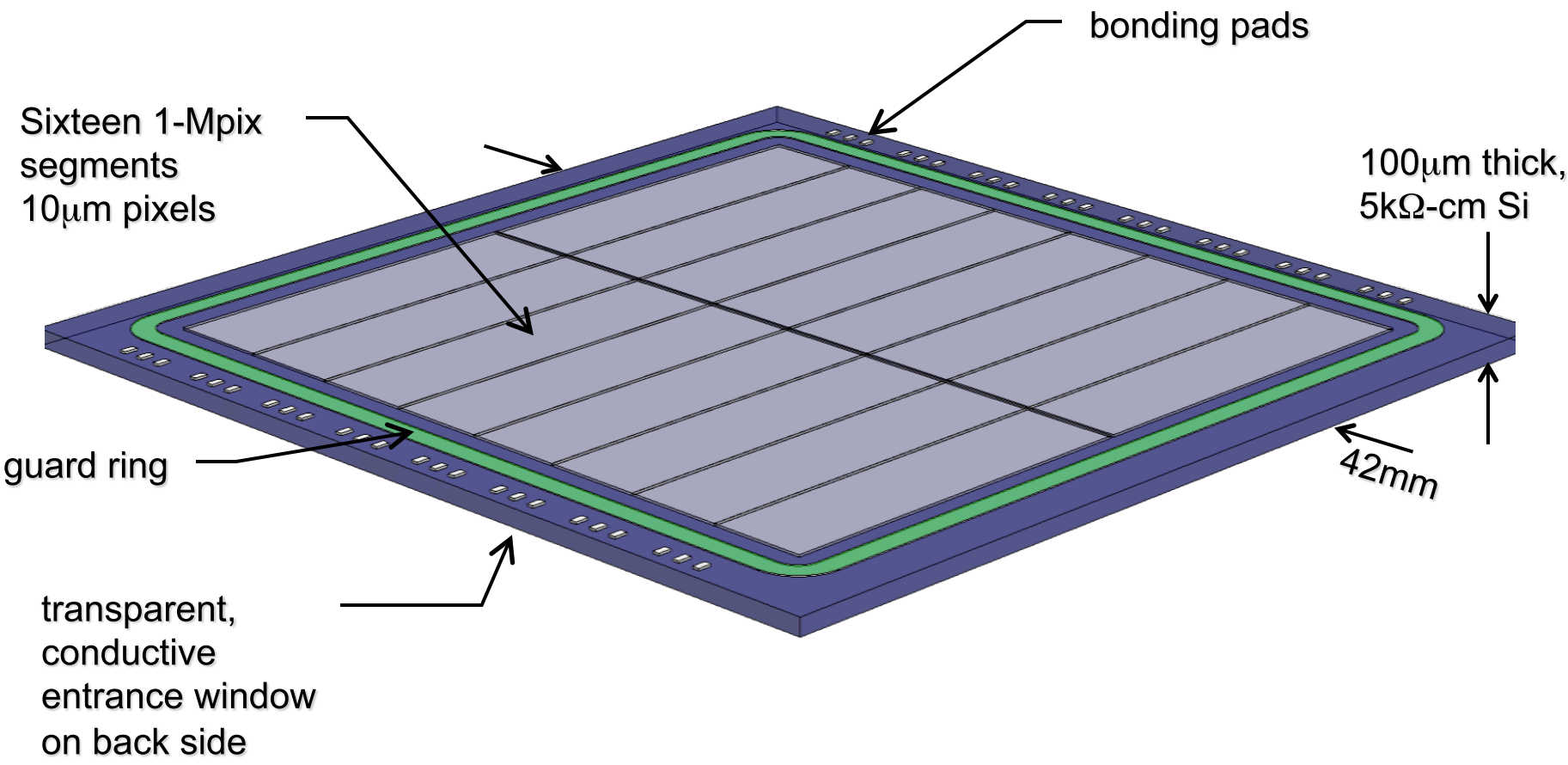


Corner Raft Assembly



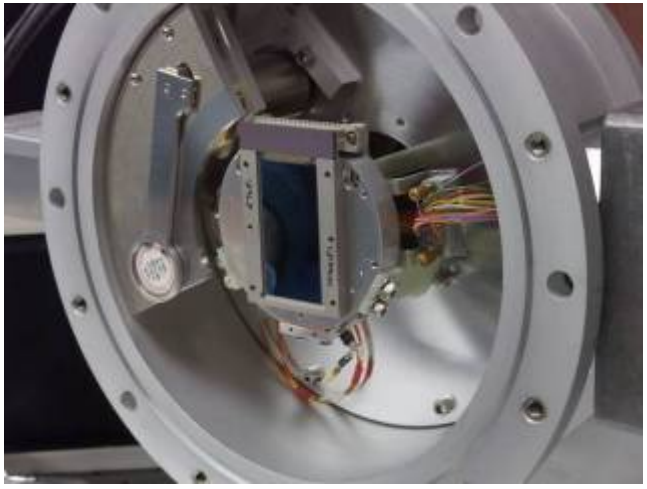


The 4K x 4K LSST sensor reference design

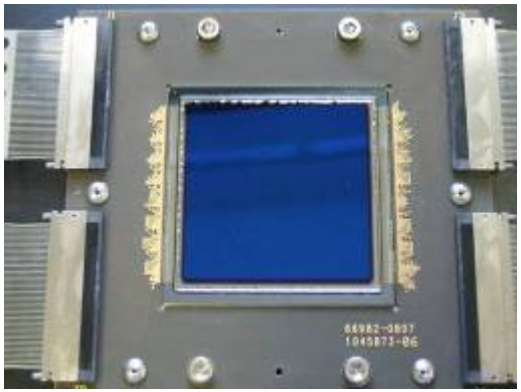


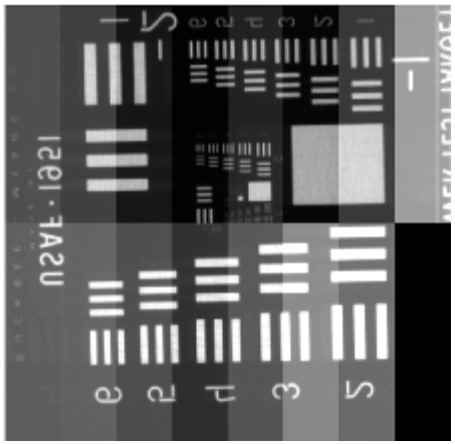
Two vendors have produced working 100μm-thick CCDs in Phase 1 development

e2v
2K x 4.5K, 13.5μm pixels, 2 outputs



STA/ITL
4K x 4K, 10μm pixels, 16 outputs

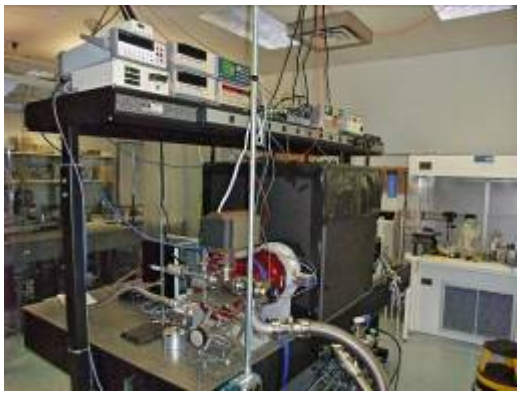




both 100μm thick, high resistivity bulk silicon, capable of overdepletion

Brookhaven and Paris are the primary sites for sensor testing

BNL CLEANROOM



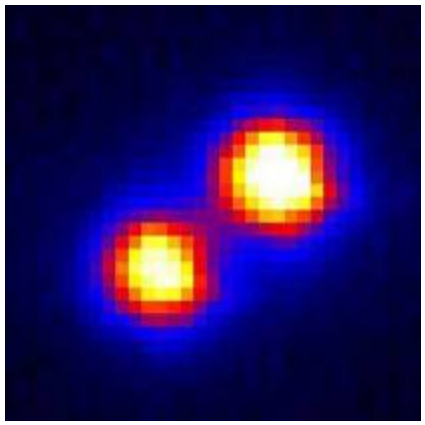
IN2P3 CLEANROOM

Common controller electronics and software

Phase 1 device testing also performed on sky

ITL/STA 1920A at Calypso

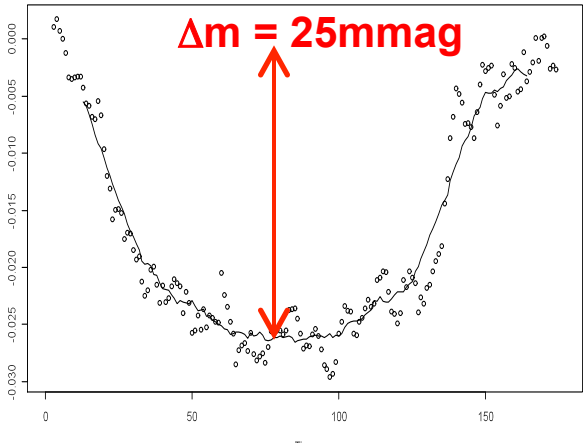
1.1” binary in y2 filter



M1 (R band, 4Kx4K)

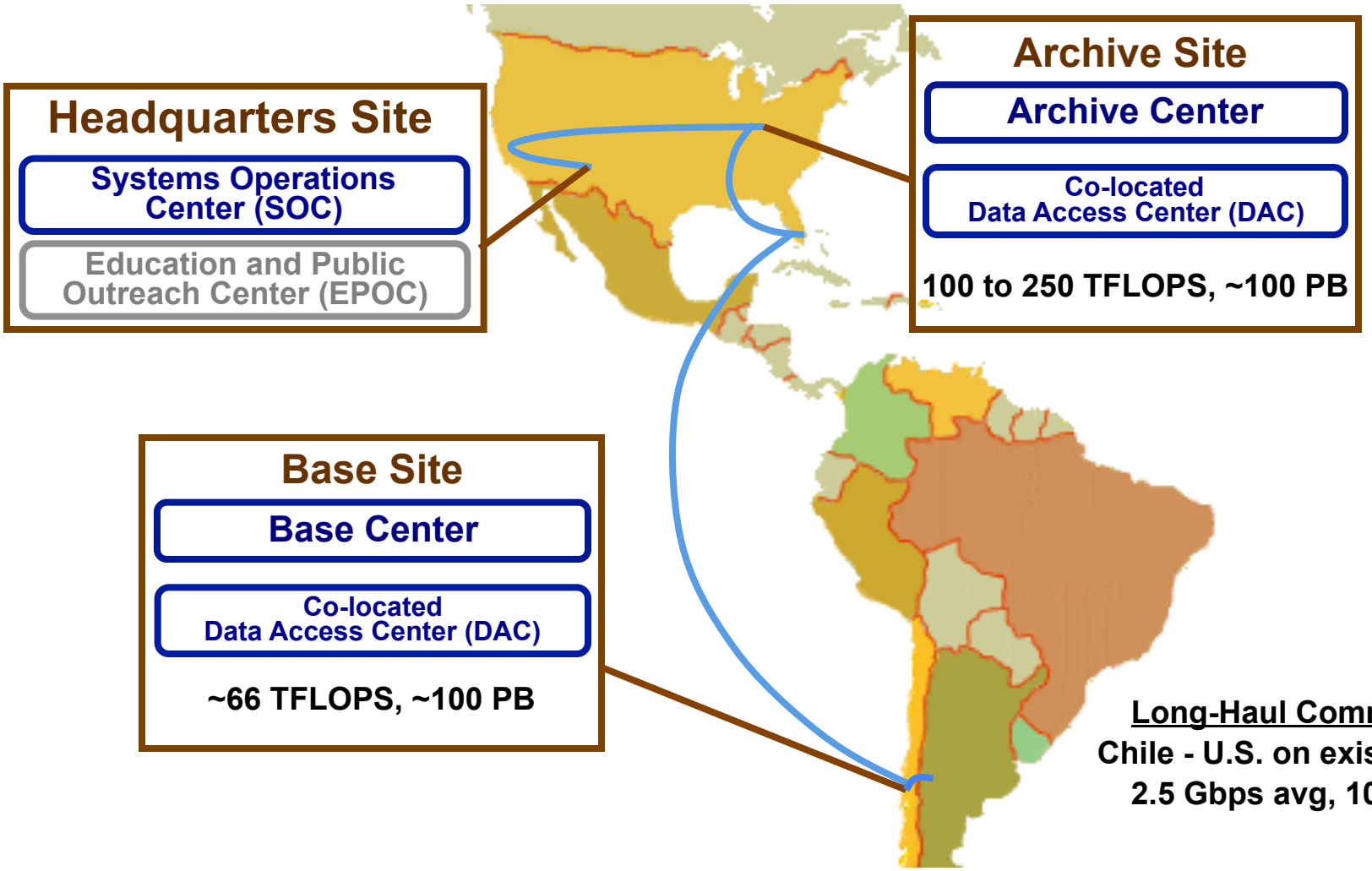
e2v CCD218-80 at MDM

Exoplanet transit lightcurve



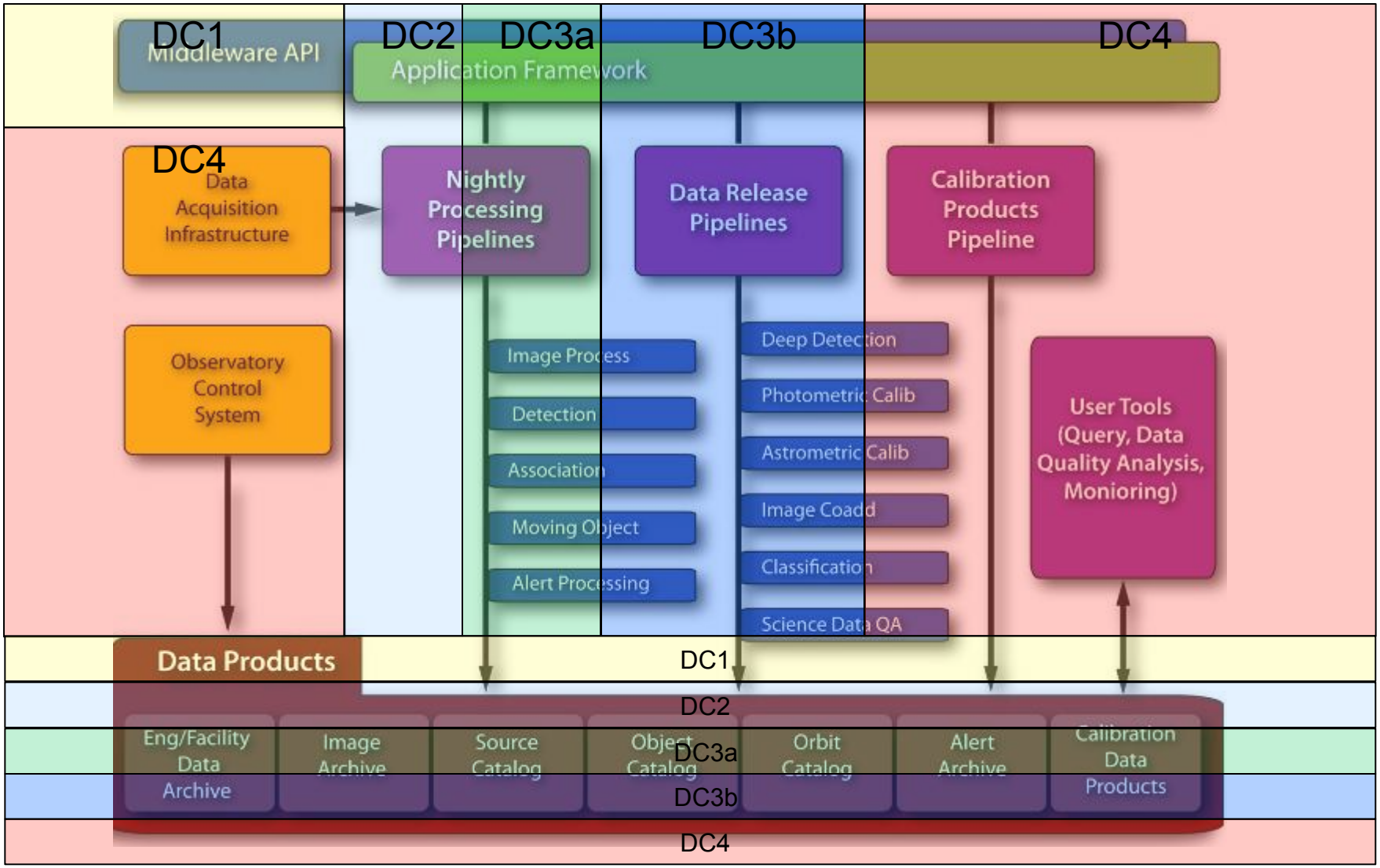
V,R,I composite (NGC891)

DM System is widely distributed leveraging world-class facilities and existing cyber-infrastructure

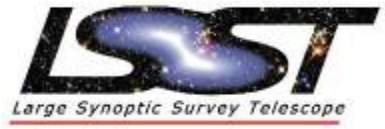


Long-Haul Communications
Chile - U.S. on existing networks
2.5 Gbps avg, 10 Gbps peak

Data Management continues Design and Testing with Data Challenges



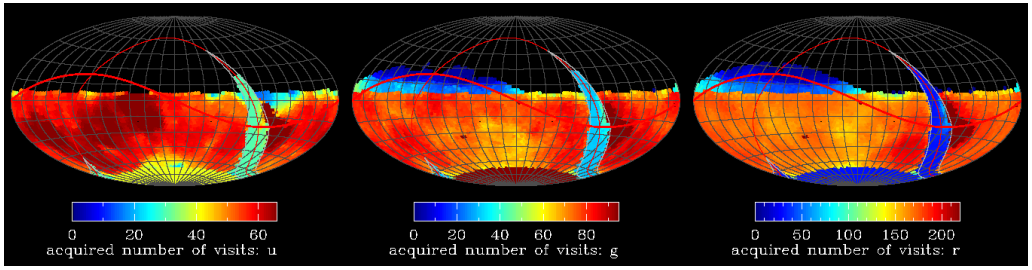
DataChallenge-3b includes: 18 pipelines, database, and user interface



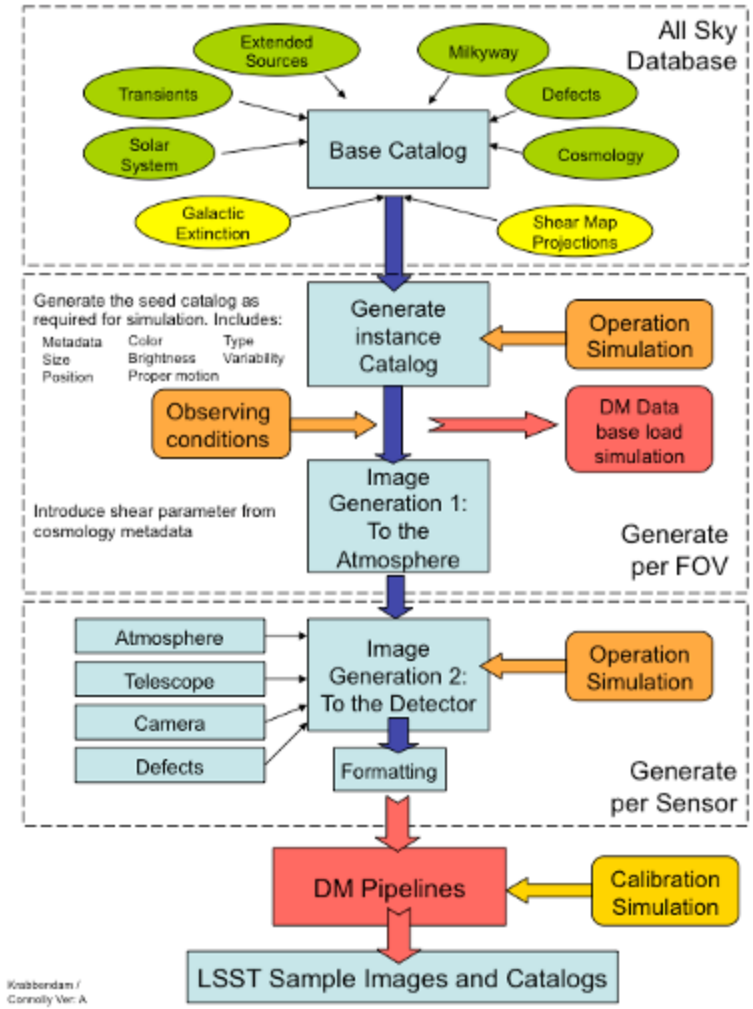
- Prototype of Data Release Production at 15% operational scale
- Three software releases/Performance Tests
  - **PT1:** (May 2010) Image Processing and Single Frame Measurement
  - **PT2:** (August 2010) Transient Detection and Deep Detection
  - **PT3:** (November 2010) Multi-fit measurement and Photometric Calibration
- 5 TB CFHTLS data, 47 TB Simulated LSST data
- Data will be served to Science Collaborations, redundant databases
- Basic user interfaces for catalog access and search
  - IPAC Gator
  - MySQL client plus custom query parallelizer (qserv)

Simulation of the LSST operation and imaging is supporting science and engineering investigations

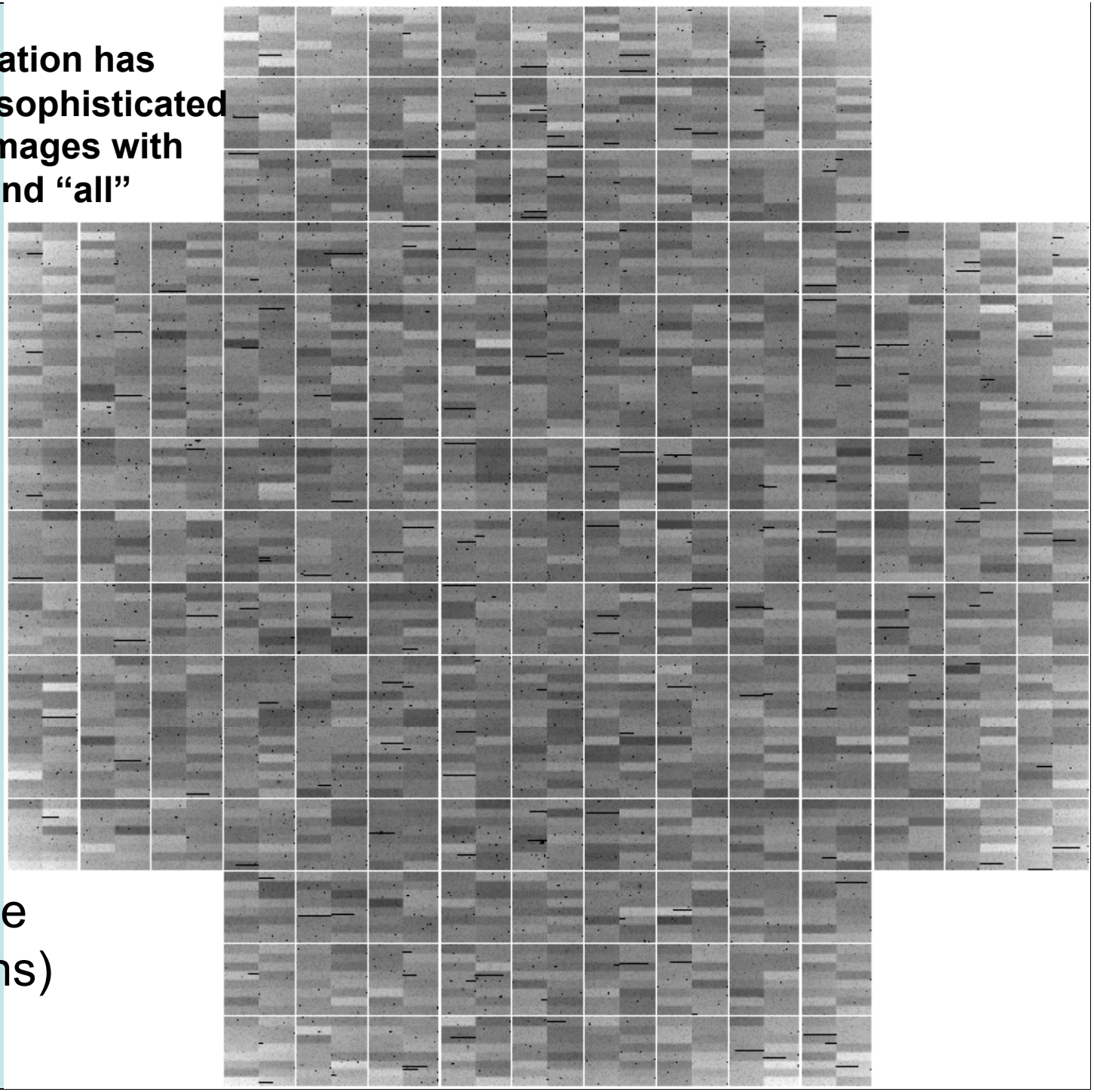
- Operations Simulations
  - Cadence input from science cases
  - Observing strategy based on historical records



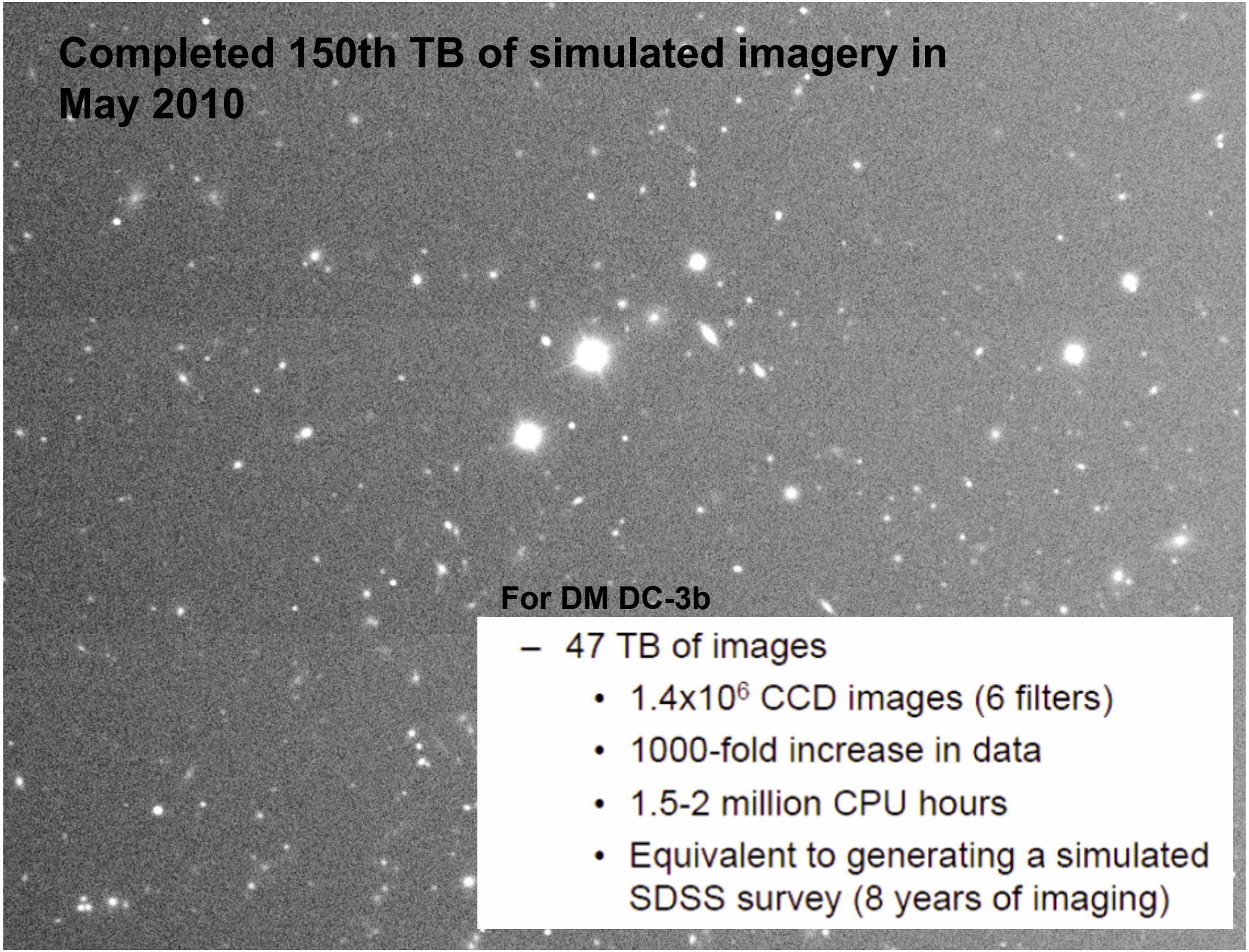
- Catalog Simulations
  - Realistic baseline catalog for validation
  - Calibration sets for all-sky applications
  - Complete to below the detection limit (r=28)
- Image Simulations
  - Photon-by-photon high fidelity image simulations
  - Atmosphere, telescope and camera
  - Validation of the design and implementation of the LSST
- A Coherent Framework



LSST Image Simulation has group developing sophisticated photon x photon images with cosmology input and "all" known physics



Full Focal Plane
(~trillion photons)



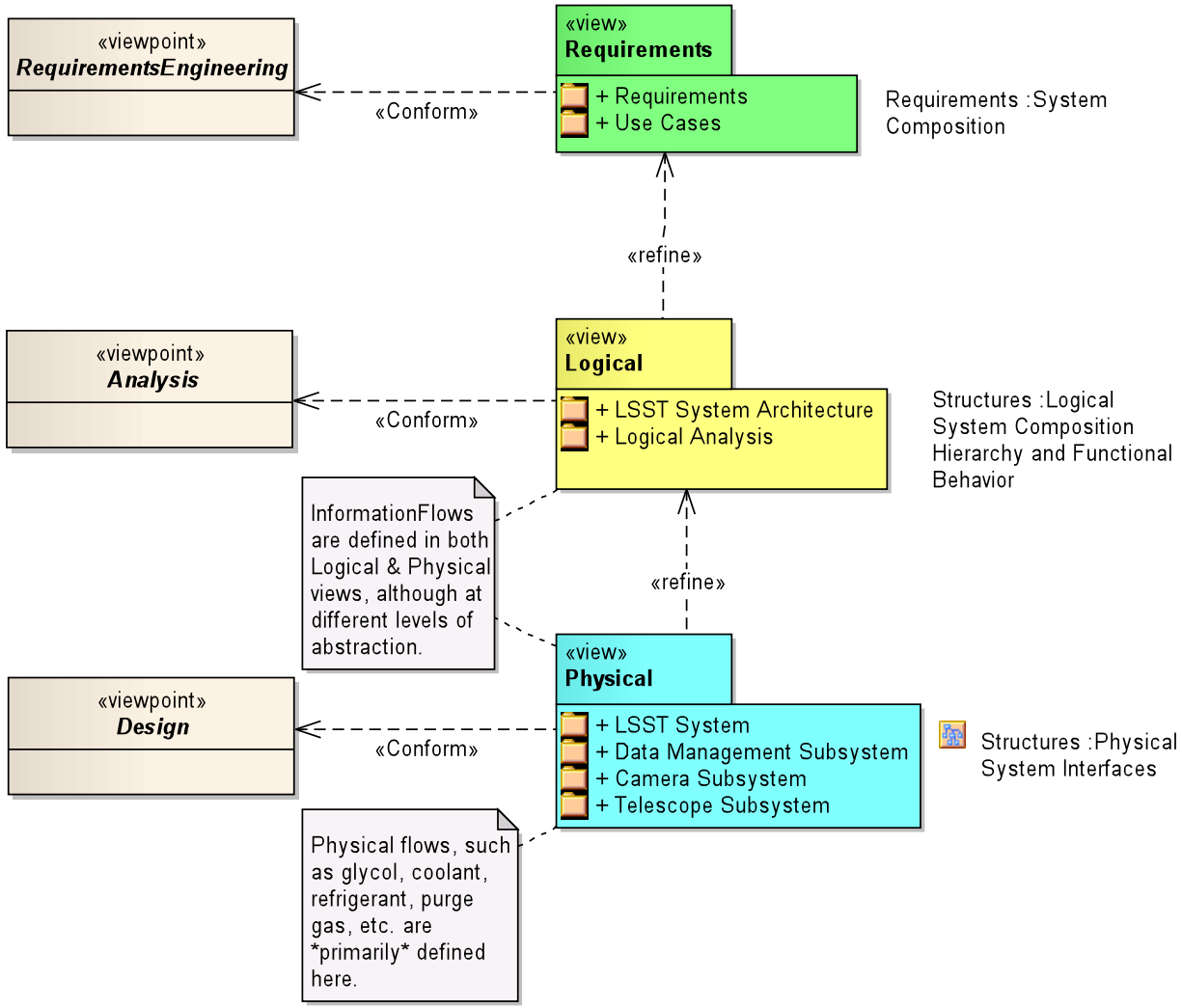
Completed 150th TB of simulated imagery in May 2010

For DM DC-3b

- 47 TB of images
  - 1.4×10^6 CCD images (6 filters)
  - 1000-fold increase in data
  - 1.5-2 million CPU hours
  - Equivalent to generating a simulated SDSS survey (8 years of imaging)

LSST has refined and fully adopted the use of SysML to guide System Engineering

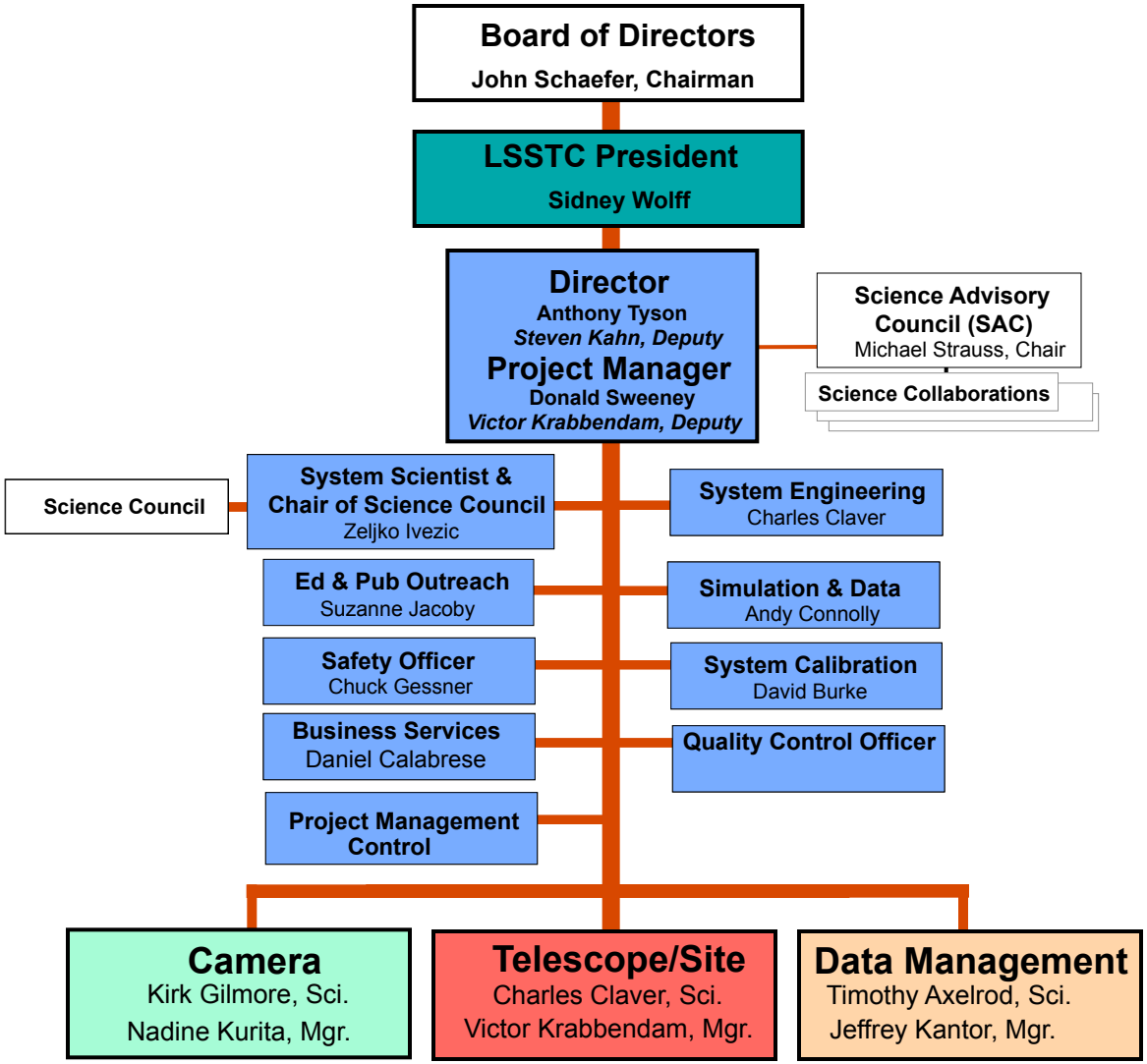
- Using Enterprise Architect Tool to capture, analyze, and verify requirements and design
- Methodology provides rigorous analysis of needs and traceability
- Configuration control point



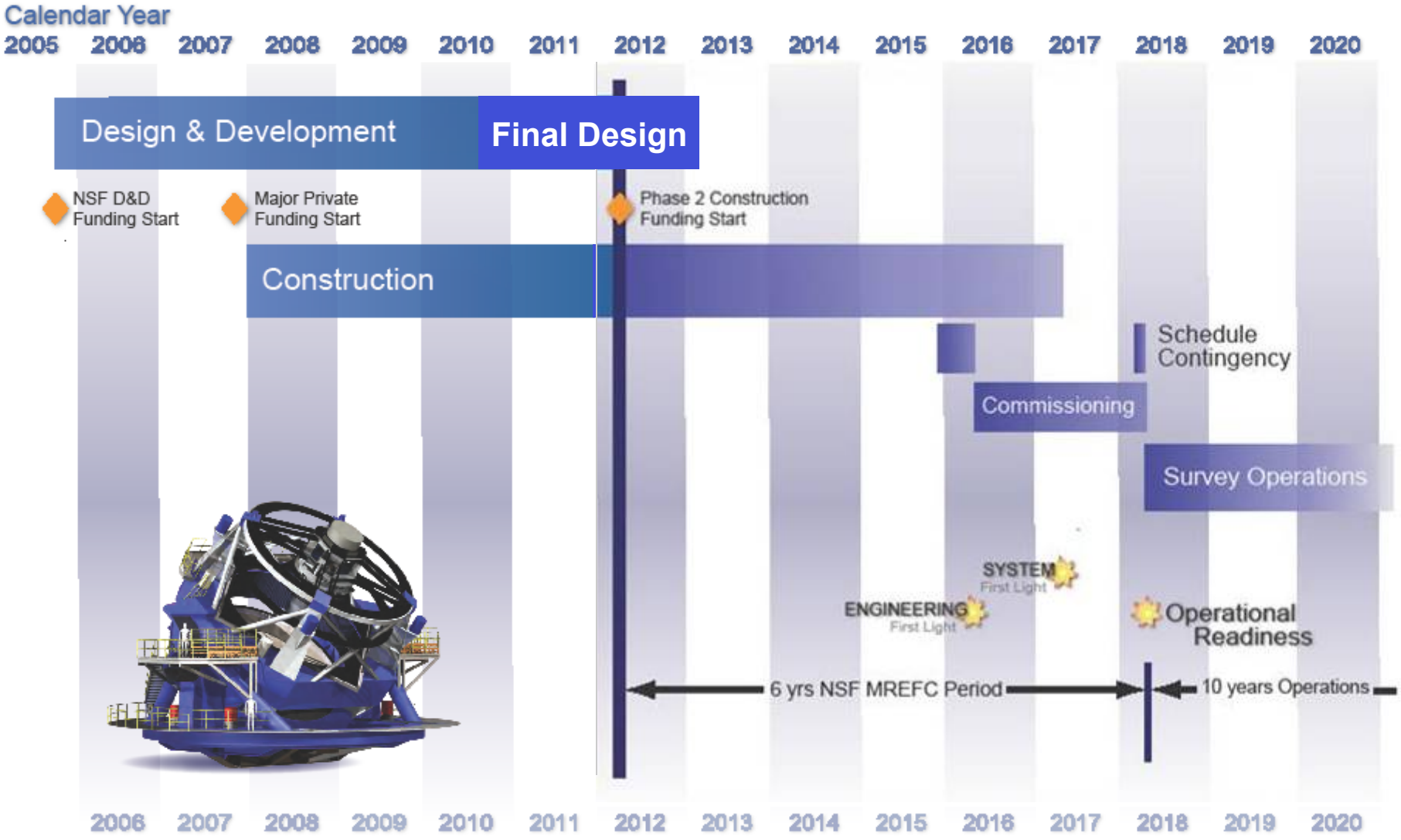
LSST is a single project managed centrally by LSST Corporation, Tucson Arizona

See www.lsst.org for list of 32 institutional partners

Institutional Members
Brookhaven National Laboratory
California Institute of Technology
Carnegie Mellon University
Chilé
Cornell University
Drexel University
Google Inc.
Harvard-Smithsonian Center for Astrophysics
Institut de Physique Nucléaire et de Physique des Particules (IN2P3)
Johns Hopkins University
Kavli Institute for Particle Astrophysics and Cosmology at Stanford University
Las Cumbres Observatory Global Telescope Network, Inc.
Lawrence Livermore National Laboratory
Los Alamos National Laboratory
National Optical Astronomy Observatory
Princeton University
Purdue University
Research Corporation for Science Advancement
Rutgers University
SLAC National Accelerator Laboratory
Space Telescope Science Institute
Texas A & M University
The Pennsylvania State University
The University of Arizona
University of California, Davis
University of California, Irvine
University of Illinois at Urbana-Champaign
University of Michigan
University of Pennsylvania
University of Pittsburgh
University of Washington
Vanderbilt University



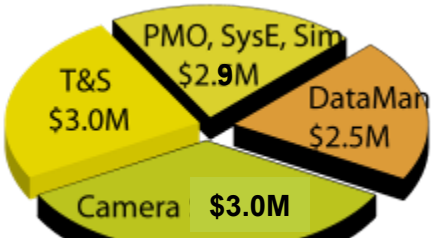
LSST schedule with a construction start in FY2012 …..now FY2013



LSST Budget and Cost estimates

Large Synoptic Survey Telescope

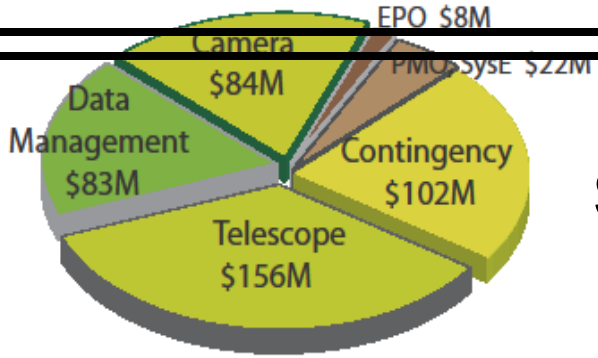
Design & Development



$11.4M/yr

Construction

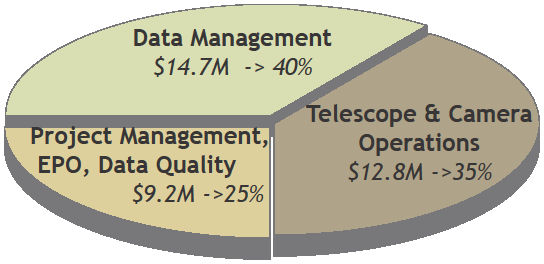
2007-2018



$455M in 2009 USD

Operations

2018-2029



36.7M/yr in 2009 USD

128 FTE total; 52 in Chile

Large Synoptic Survey Telescope

Large Synoptic Survey Telescope

LLNL continues to be a key technical partner and scientific participant in this forefront astrophysical program